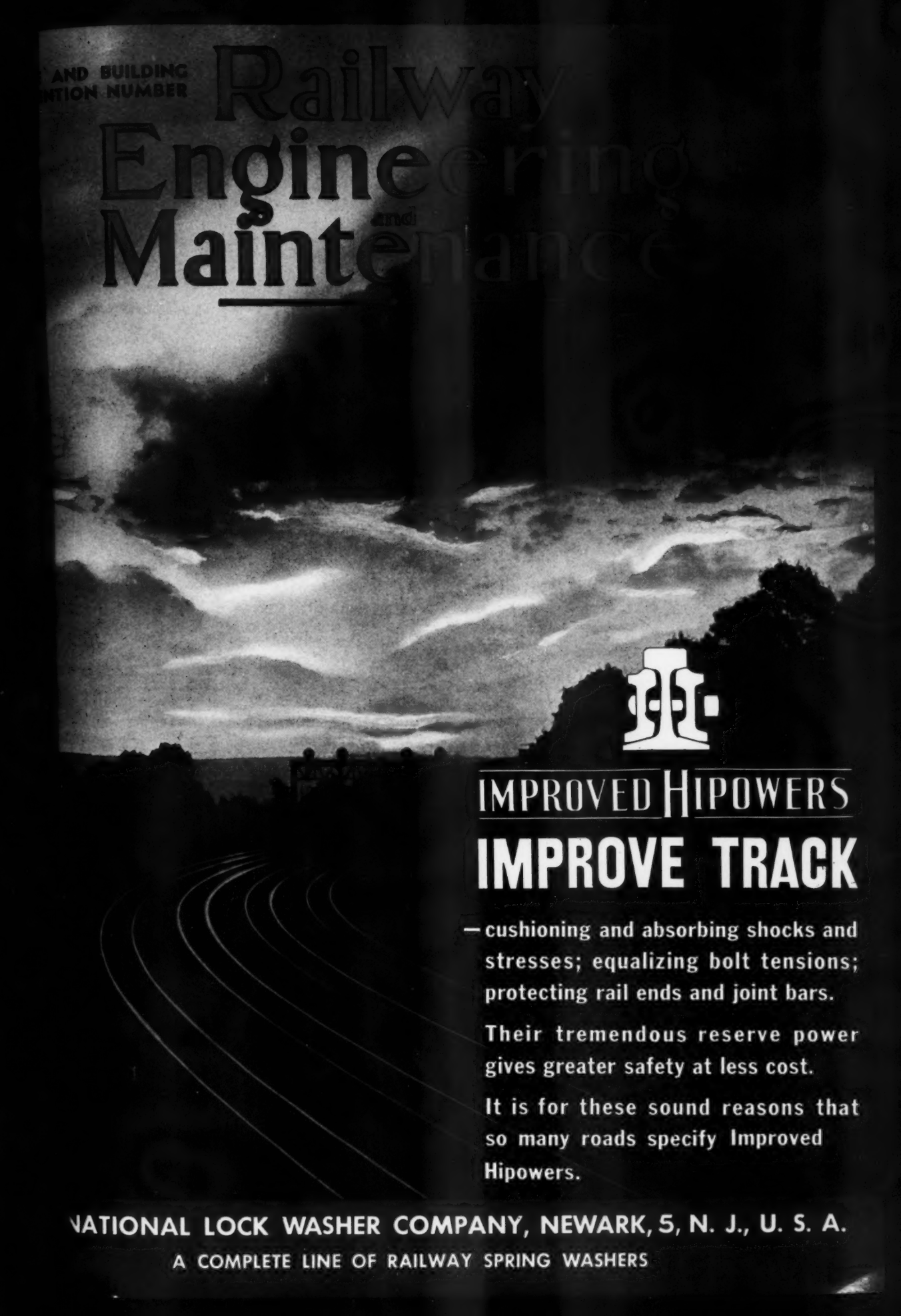

AND BUILDING
NTION NUMBER
Railway
Engineering
and
Maintenance
IMPROVED HIPOWERS
IMPROVE TRACK
— cushioning and absorbing shocks and stresses; equalizing bolt tensions; protecting rail ends and joint bars.
Their tremendous reserve power gives greater safety at less cost.
It is for these sound reasons that so many roads specify Improved Hipowers.
NATIONAL LOCK WASHER COMPANY, NEWARK, 5, N. J., U. S. A.
A COMPLETE LINE OF RAILWAY SPRING WASHERS

Pretty Tough

ON RAIL JOINTS

Horseshoe curves like this one on the Southern Pacific above Truckee, California, are always tough problems for the maintenance engineer. Adding heavy wheel loads and fast speeds to the steep grades creates the toughest of maintenance conditions.

In spots like this, Reliance Hy Pressure Hy-Crome Spring Washers prove their worth. Their inherent reactive pressure automatically compensates for bolt looseness caused by wear, and makes it possible to keep rail joint bolts *tighter longer*. Physical qualities exceeding A. R. E. A. requirements guarantee longer non-fatiguing service.

Write for illustrated folder detailing track applications of Reliance Hy-Pressure Hy-Crome Spring Lock Washers.

EATON

EATON MANUFACTURING COMPANY

OFFICES AND PLANT **MASSILLON, OHIO**

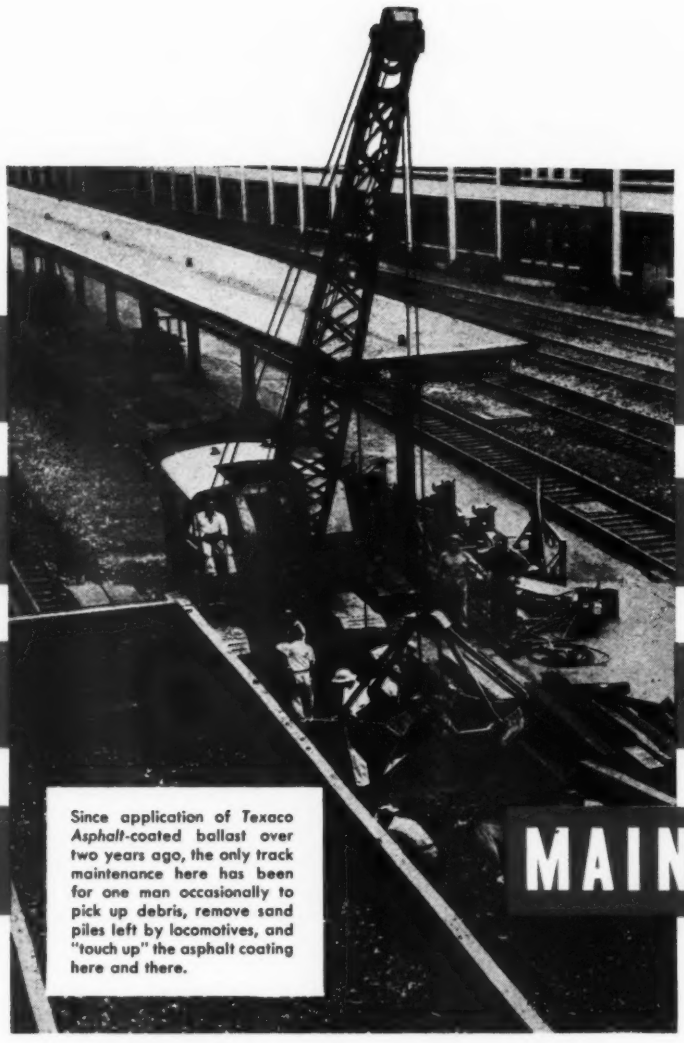
Reliance Division

Sales Offices: **New York • Cleveland • Detroit • Chicago • St. Louis • San Francisco • Montreal**

Published monthly by Simmons-Boardman Publishing Corporation, 105 W. Adams St., Chicago 3, Ill. Subscription price: United States and Possessions, and Canada, $3.00 for one year; $3.00 for two years. Single copies 50 cents. Entered as second-class matter January 20, 1933, at the post office at Chicago, Ill., under the act of March 3, 1879, with additional entry at Mount Morris, Ill., post office. Address communications to 105 W. Adams St., Chicago 3, Ill.

THE BALLAST THAT . . .

REDUCES STATION TRACK MAINTENANCE



Since application of Texaco *Asphalt*-coated ballast over two years ago, the only track maintenance here has been for one man occasionally to pick up debris, remove sand piles left by locomotives, and "touch up" the asphalt coating here and there.

COST of maintaining track through stations is frequently excessive, due to draining difficulties. Stone ballast coated with *Texaco Asphalt* establishes and holds proper drainage conditions, and reduces maintenance costs to merely nominal charges.

The sealcoat formed by *Texaco Asphalt* sheds water quickly and prevents fouling of ballast with dirt and cinders.

In addition, ballast coated with *Texaco Asphalt* keeps the track in good line and surface longer. It stays flexible . . . does not crack under heavy traffic . . . and can be tamped even after long service.

The lasting effectiveness and economy of this better ballast springs from the high quality of *Texaco Asphalt*—proved through forty years of service on America's streets, highways and railroads.

For the full story of the savings in track maintenance costs possible with *Texaco Asphalt,* call the nearest Railway Sales Division Office listed below, or write:

The Texas Company, *Railway Sales Division,* 135 East 42nd Street, New York 17, New York.

NEW YORK • CHICAGO • SAN FRANCISCO • ST. PAUL • ST. LOUIS • ATLANTA

TEXACO

TEXACO Asphalt for Coating Ballast

Tune in . . . TEXACO STAR THEATRE presents the TONY MARTIN SHOW every Sunday night. See newspaper for time and station.

Simplicity of Design

Here is the deck view of a Northwest. Note the simplicity of design. There are only two main horizontal shafts and all assemblies are readily accessible.

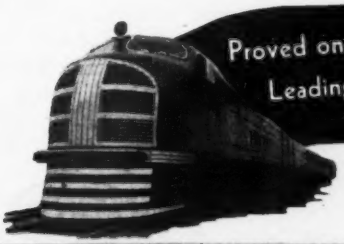
Gears too, are few in number. Compare this with the complications of other machines. Simplicity means lower cost operation and maintenance.

Keeps Maintenance Costs Down!

DESIGN complications mean higher upkeep costs. Northwest simplicity assures easy maintenance. Look at the deck of a Northwest. Simple, isn't it! Only two main shafts, few gears, a direct line of power without complications. Everything *get-at-able*, easy to adjust, easy to maintain.

Simplicity of design means better service—uninterrupted service. Your Northwest is always ready to go when you need it. It eliminates much of the time lost with track type equipment. It is not confined to definite areas and goes anywhere for either on the line or off the line work. Another of the many Northwest advantages that make Northwest preferred equipment on so many Class I Railroads.

NORTHWEST ENGINEERING COMPANY
1513 Field Building, 135 South LaSalle St.
Chicago 3, Illinois



NORTHWEST

THE ALL PURPOSE RAILROAD MACHINE
SHOVEL • CRANE • DRAGLINE • PULLSHOVEL

Flame Cleaning

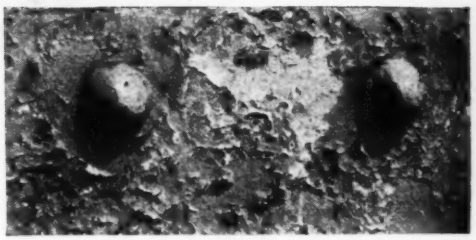
prepares bridge members for painting

Leading railroads find that flame cleaning quickly prepares bridges, trestles and other metal surfaces for painting—*with savings up to one half the cost of hand scraping and chipping.* Further, in addition to actual dollar savings, they found that the flame cleaned surface produced a better finished paint job.

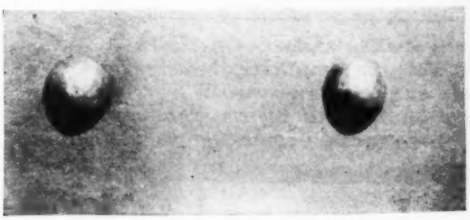
Quickly, easily and safely applied, the Airco flame cleaning process provides a clean, warm and dry surface conducive to a lasting paint job. The oxyacetylene flame cockles old paint, loosens scale and drives off hidden moisture . . . gives longer paint life to all kinds of steel structures.

New steel structures, too, should be flame cleaned before application of the prime coat of protection. This method loosens semi-tenacious mill scale and leaves no corrosion-starting dirt or hidden moisture. Future maintenance costs are reduced to an absolute minimum.

For further details write for folder ADG-1066B — "Flame Cleaning and Dehydrating Old Steel Structures", and folder ADG-1067A—"Flame Cleaning and Dehydrating New Steel Structures". Address: Dept. REM-7320, Air Reduction, General Offices: 60 East 42nd Street, New York 17, N. Y. In Texas: Magnolia Airco Gas Products Company, Houston 1, Texas. Represented Internationally by Airco Export Corporation.



BEFORE — *Close-up view shows conditions of paint-lift heavy rust and scale that were met.*



AFTER — *The finished job after flame cleaning. A smooth, clean, dry surface ready for a lasting coat of paint.*

Costs come down under the Airco Plan

AIRCO **AIR REDUCTION**

Offices in All Principal Cities

For additional information, use postcard, pages 1077-1078

STEP UP THE AVAILABILITY OF YOUR DIESELS with *Adequate Refueling Equipment*

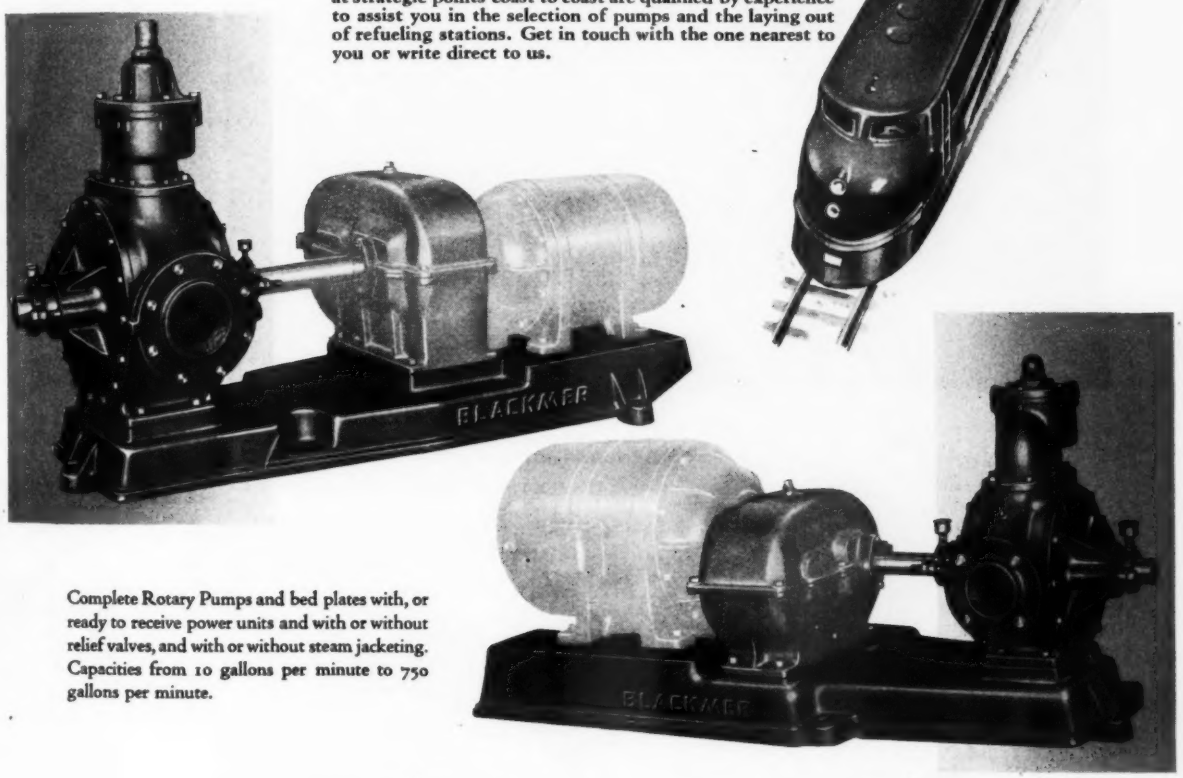
WHEN your Diesels have to be refueled in a matter of minutes to meet tight doubling-back schedules, you can rely on Blackmer Rotary Pumps every time. They have abundant overload capacity to meet any refueling requirements . . . operating pressures to take care of the lift and head. Blackmer design compensates for wear and guarantees sustained capacity.

Dieselized divisions of many railroads, among them . . . New York Central, Santa Fe, Chesapeake & Ohio, Burlington, Union Pacific, Chicago and North Western . . . depend upon Blackmer Pumps for refueling from underground tanks at large terminals or from aboveground tanks out on the line. Two units especially suitable for refueling purposes are illustrated here.

SIMPLICITY OF DESIGN . . . EASY TO SERVICE

In Blackmer installations, stand-by equipment is unnecessary. Even if a Blackmer Pump should break down while operating, most of the working parts when worn can be replaced in a very few minutes . . . and the pump is ready to go!

Twenty-eight Blackmer Pump Service Engineers located at strategic points coast to coast are qualified by experience to assist you in the selection of pumps and the laying out of refueling stations. Get in touch with the one nearest to you or write direct to us.



Complete Rotary Pumps and bed plates with, or ready to receive power units and with or without relief valves, and with or without steam jacketing. Capacities from 10 gallons per minute to 750 gallons per minute.

Blackmer Pumps

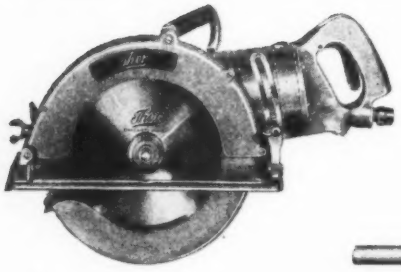
THE HEART ♥ OF YOUR LIQUID HANDLING SYSTEM

Blackmer Pump Company • Grand Rapids 9, Michigan

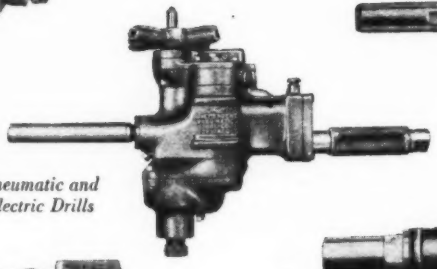
PUT *Thor* IN THE GANG...

Thor Breakers are available in a full range of sizes and styles for digging, tamping, spike driving, concrete breaking, driving sheeting and many other operations.

Thor Pneumatic Breakers are ideal for driving grouting points. Mud points are accurately driven with minimum effort mile after mile.

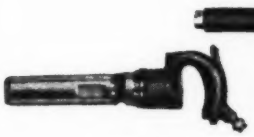


Pneumatic and Electric Saws



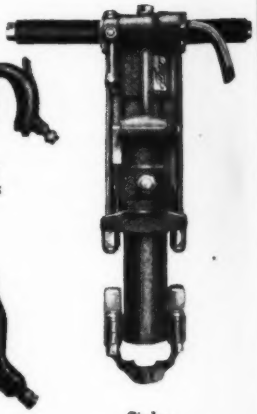
Pneumatic and Electric Drills

Pneumatic and Electric Grinders



Riveting Hammers

Chipping Hammers

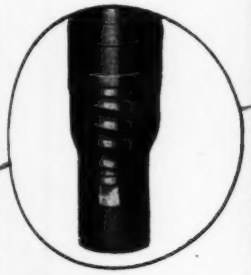


Sinker Rock Drills

.....to speed track and building jobs

ALL ALONG THE LINE

Progressive track-laying is accelerated with the aid of Thor Pneumatic Breakers equipped with spike-driving heads.



Regular head is quickly replaced by special head for driving spikes.

Thor Tools will figure vitally in the tremendous track and building program facing all railroads. More and bigger gangs will travel the sections, and with many will go the Thor Tools long established as time, cost and labor savers on all section jobs . . . grouting, spike driving, digging, tamping, rock breaking, chipping, sawing, drilling and riveting. Put Thor *power* . . . *speed* . . . *performance* in YOUR gang—call your nearby Thor branch today for demonstration.

INDEPENDENT PNEUMATIC TOOL COMPANY

600 W. Jackson Boulevard, Chicago 6, Illinois

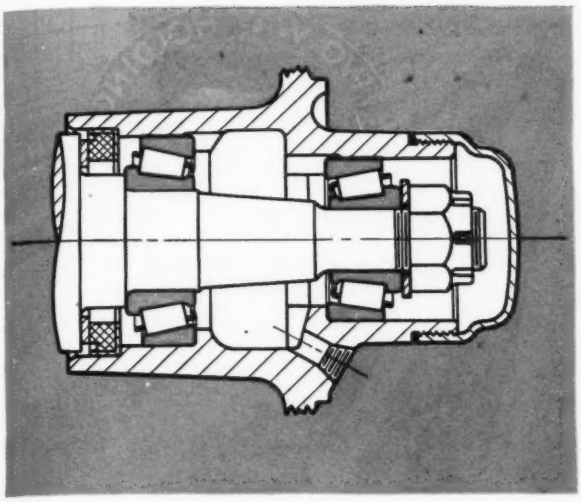
Birmingham Boston Buffalo Cincinnati Cleveland Denver Detroit Houston Los Angeles Milwaukee
New York Philadelphia Pittsburgh St. Louis St. Paul Salt Lake City San Francisco Toronto, Canada London, England

Sump Pumps

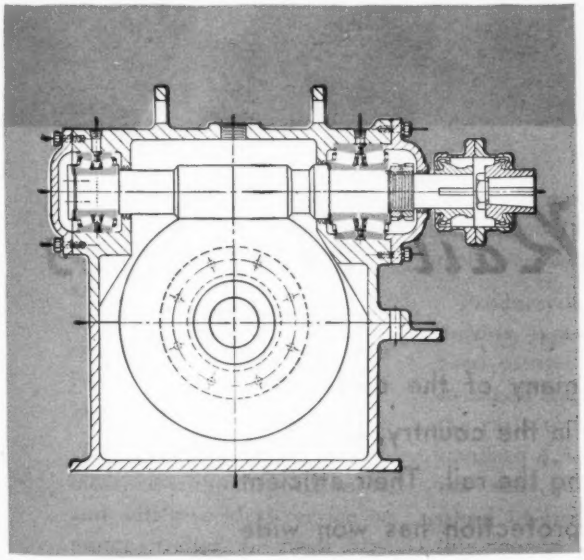
Thor PORTABLE POWER TOOLS

PNEUMATIC TOOLS • UNIVERSAL AND HIGH FREQUENCY ELECTRIC TOOLS • MINING AND CONTRACTORS TOOLS

How to carry combinations of radial and thrust loads



TRACTOR FRONT WHEEL *in which both thrust and radial loads are carried on single row Timken bearings. From whichever way the load may come, it will be handled with minimum friction and wear.*



APPLICATION *of Timken Bearings on the worm shaft of a worm gear drive. The load on the worm shaft bearings, due to the operation of the worm, is primarily thrust. There is considerable radial load however, arising from the separating force of the gears and also possibly from overhung driving loads. This is another application for which the tapered roller bearing is ideal.*

THESE drawings show how Timken tapered roller bearings are effectively used where both radial and thrust loads must be carried. They may give you an idea for projects now on your boards.

Because it is a *roller* bearing, the Timken bearing can carry the heaviest loads. Because its rolls are *tapered,* it can carry both radial and thrust loads in any combination.

From whichever direction the loads may come, this tapered design enables the Timken bearing to carry them, one at a time or simultaneously. The cost of providing a separate type of bearing for each load is eliminated. Bearing housings and mountings are simplified, with a saving in cost, weight, and space.

For help in putting these important advantages of Timken bearings to work in the product you're designing, call upon the confidential service of the Timken engineer. He will help you select the precisely correct bearing for your job.

Remember, Timken is the only bearing manufacturer which makes its own steel. And Timken is the acknowledged leader in: 1. advanced design; 2. precision manufacture; 3. rigid quality control; 4. special analysis steels.

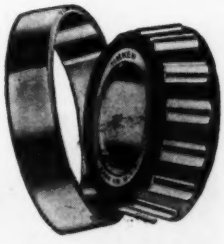
Additional copies of this page and further information on this or other applications of Timken bearings are yours for the asking. Write — The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN GIVES YOU THESE IMPORTANT FEATURES:

1. TRUE ROLLING MOTION
All lines drawn coincident with the faces of rollers, cone and cup meet at a common point on the axis of the bearing.

2. GREATER LOAD CAPACITY
Load is distributed along full length of roller, giving greater capacity, precision, and rigidity, with less wear and distortion.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ⊂ THE TIMKEN TAPERED ROLLER ⊃ BEARING TAKES RADIAL ◎ AND THRUST —◎— LOADS OR ANY COMBINATION —◎—

Compression Rail Anchors

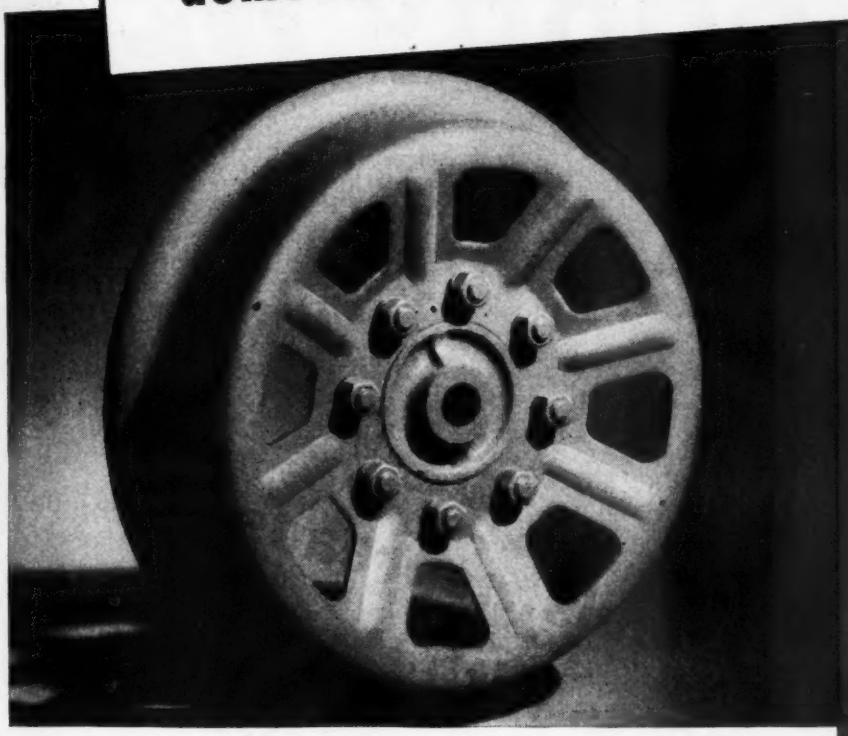
IT IS significant that on many of the outstanding bridge and viaduct jobs in the country, Compression Rail Anchors are holding the rail. Their efficient and economical two-way protection has won wide recognition among bridge engineers.

THE RAILS COMPANY

General Office
178 GOFFE STREET, NEW HAVEN 11, CONN.

ST. LOUIS, MO. HOBOKEN, N. J. CHICAGO, ILL.

Now... a longer-mileage demountable-hub wheel!

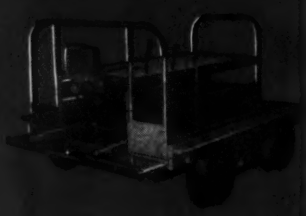


COLD-PRESSED from a single sheet of steel . . . reinforced with extra thickness over the areas of greatest wear . . . utilizing a die-forged demountable hub . . . this is the new Fairbanks-Morse Demountable-Hub Wheel.

It can be mounted or demounted without special tools, and will give ideal service on motor, trailer, or push cars. You are assured absolute uniformity in every wheel, because Fairbanks-Morse rigidly controls every step of manufacture.

Products of 117 years of production experience, they have been proved the lightest and strongest track car wheels on the rails today. Available in standard A.R.E.A. 16- and 20-inch sizes, plus a newly developed 14-inch wheel. Send this coupon now for the new descriptive bulletin.

Fairbanks-Morse Push Cars
A complete line for every requirement.



Fairbanks-Morse Motor Cars
"First on the rails and still first." Models for all needs.

Fairbanks-Morse Pumps
A full line of complete units for all requirements.

Fairbanks-Morse Scales
Every type and capacity, including track scales and Printomatic Scales, pictured.

Fairbanks, Morse & Co.
Dept. Y-2
Chicago 5, Illinois

Gentlemen:

Please send new bulletin on Fairbanks-Morse Demountable-Hub Steel Wheels with new die-forged steel hubs.

Name _____

Address _____

City _____

State _____

Fairbanks-Morse

A name worth remembering

Diesel Locomotives • Diesel Engines
Generators • Motors • Pumps • Scales
Magnetos • Stokers • Railroad Motor Cars and Standpipes • Farm Equipment

Simplify your
this handy *NEW*

LET

See your LeTourneau Railroad Distributor NOW for complete information

coal storage with D TOURNAPULL

WHY GO to the extra expense of special one-purpose equipment for stockpiling coal, when you can do the job faster, easier, better with a D Tournapull — and at the same time gain a money-saving tool for general maintenance and clean-up work.

As a coal handler, this one-man Tournapull can move approximately 2 tons of coal per trip* . . . haul at average truck speeds . . . spread each load in smooth, shallow layers . . . compact coal without damage through cushioning action of big low-pressure tires.

Tournapull method of piling saves valuable storage space . . . minimizes danger of spontaneous combustion . . . permits greater flexibility because small stockpiles of coal can be maintained at locations most convenient for serving shops and equipment.

Get the facts on this versatile one-man coal handler today. Find out, too, about its many other applications such as: grading right-of-way, removing earth slides, filling wash-outs . . . spreading ballast, etc.

See your LeTourneau Distributor or write:

R. G. LeTOURNEAU, Inc., Peoria, Ill.

*Larger Tournapulls handle up to 16 tons of coal per trip.

Tournapull—Trademark Reg. U.S. Pat. Off. CH-3

New D Tournapull hauls approximately 2 tons of coal per trip . . . travels over pavement or cross country at speeds up to 23 m.p.h. . . . crosses tracks at will. Rig is self-loading . . . works alone or in fleets.

LETOURNEAU PEORIA, ILLINOIS — HIGH-SPEED UTILITY — TOURNAPULLS

FLEXSTONE BUILT-UP ROOFS

"Made of asbestos, each ply is a flexible covering of stone"

RESISTS FIRE: Burning embers or brands, blown from neighboring fires, burn out harmlessly on Flexstone Roofs. In spite of the intense heat and flame, the asbestos felts prevent the roof deck from catching fire. Here's further assurance that you get greater fire-safety with Johns-Manville Flexstone Built-Up Roofs.

BUILT-UP with asbestos felts which are fireproof, rot-proof, and weatherproof, Johns-Manville Flexstone Roofs offer the most enduring and reliable protection for your buildings.

Flexstone Roofs are *smooth-surfaced,* permitting quick and thorough roof drainage. They won't dry out from the sun . . . require no periodic coating. Upkeep expense is minimized, because the actual roof can be seen . . . any damage is easily located.

All Johns-Manville Flexstone Roofs are engineered to the particular requirements of your building—whether it's new construction or a re-roofing project.

Three grades are available: *Flexstone Super "A", Flexstone Standard,* and *Flexstone Service*—each the finest that can be specified for its purpose. Write for our brochure BU-51A. Address Johns-Manville, New York, Chicago, Cleveland, St. Louis or San Francisco.

Johns-Manville

89 YEARS OF SERVICE TO TRANSPORTATION

Clear the Way — for the Rails

with

INTERNATIONAL Diesel Crawlers

Relocating a rail line calls for a lot of land clearing and earth work. International Diesel Crawlers, equipped with matched clearing dozers, are the machines for this work.

On the job pictured, an International TD-9 was used to clear the land of stumps, trees and roots along a new, 13½ mile right-of-way, 90 to 160 feet wide. Total area was 285 acres. $35 per acre was the cost at that time.

This is evidence of International Diesel unbeatable operating economy. Efficient conversion of fuel into power, low maintenance costs and great stamina are factors which give Internationals the edge. Their sure-footed traction, speed and maneuverability make them leaders among earth moving tractors.

Your nearby International Industrial Power Distributor will gladly help you select the right size of tractor, power unit or powered equipment for your on-rail, off-rail or in-yard jobs. Be sure to see what he has to offer.

Industrial Power Division

INTERNATIONAL HARVESTER COMPANY

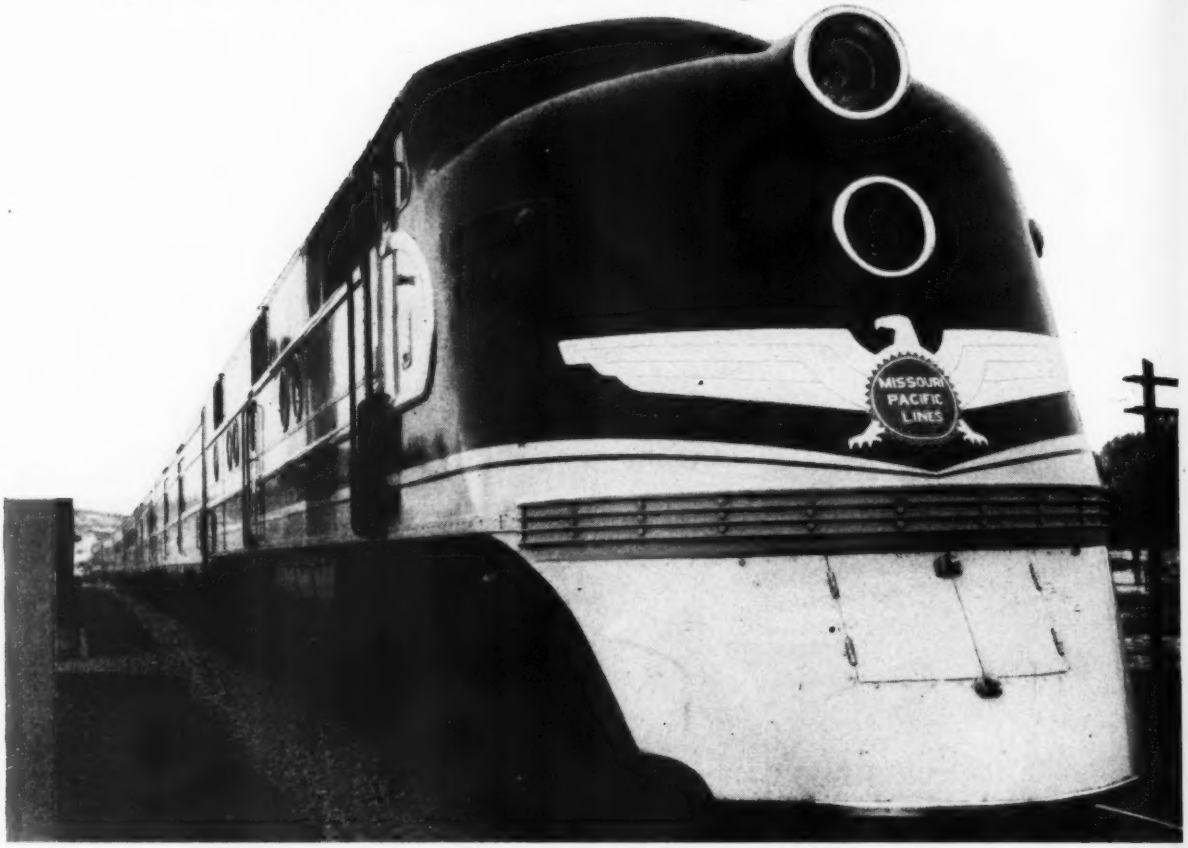
180 North Michigan Avenue Chicago 1, Illinois

INTERNATIONAL HARVESTER

INTERNATIONAL *POWER*

CRAWLER AND WHEEL TRACTORS • DIESEL ENGINES • POWER UNITS

MODERN POWER REQUIRES

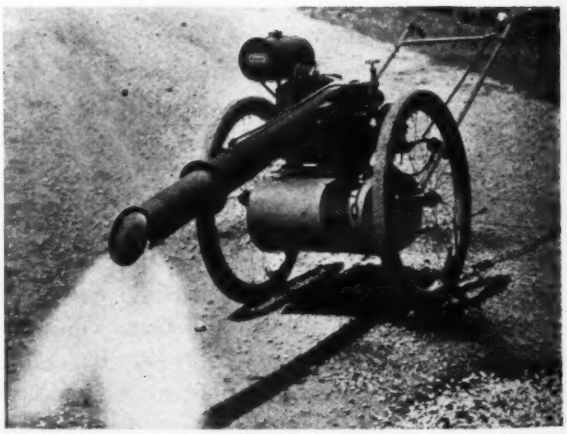


Modern Track Maintenance

ALONG with other lines, the Missouri Pacific makes effective use of Woolery Weed Burners to aid in maintaining weed-free track—an aid to the handling of heavy traffic, at high speeds.

In fact, the use of Woolery Tie Cutters and Creosote Sprayers, as well as Woolery Weed Burners, by more than 75 railroads gives evidence of the advantages of employing this equipment.

WOOLERY WEED BURNERS are available in 5-burner, 3-burner, 2-burner and 1-burner models.



The new Model AJX—Portable Weed Burner (right) is especially adapted for use in yards, along fence rows, for melting snow and ice at switches, and for thawing bottoms of hopper cars. It is mounted on two steel or rubber-tired wheels, weighs approximately 100 pounds, and carries a nine-gallon tank. The swivel-mounted burner permits the flame to be focused on either side, or turned as required for thawing cars.

WOOLERY MACHINE COMPANY

MINNEAPOLIS — Pioneer Manufacturers of — MINNESOTA

RAILWAY MAINTENANCE EQUIPMENT

RAILWAY WEED BURNERS • MOTOR CARS • TIE CUTTERS • TIE SCORING MACHINES • RAIL JOINT OILERS • CREOSOTE SPRAYERS • BOLT TIGHTENERS

EXCLUSIVE EXPORT REPRESENTATIVES: PRESSED STEEL CAR COMPANY, INC., PITTSBURGH, PENNA.

Operation "Mudhole"

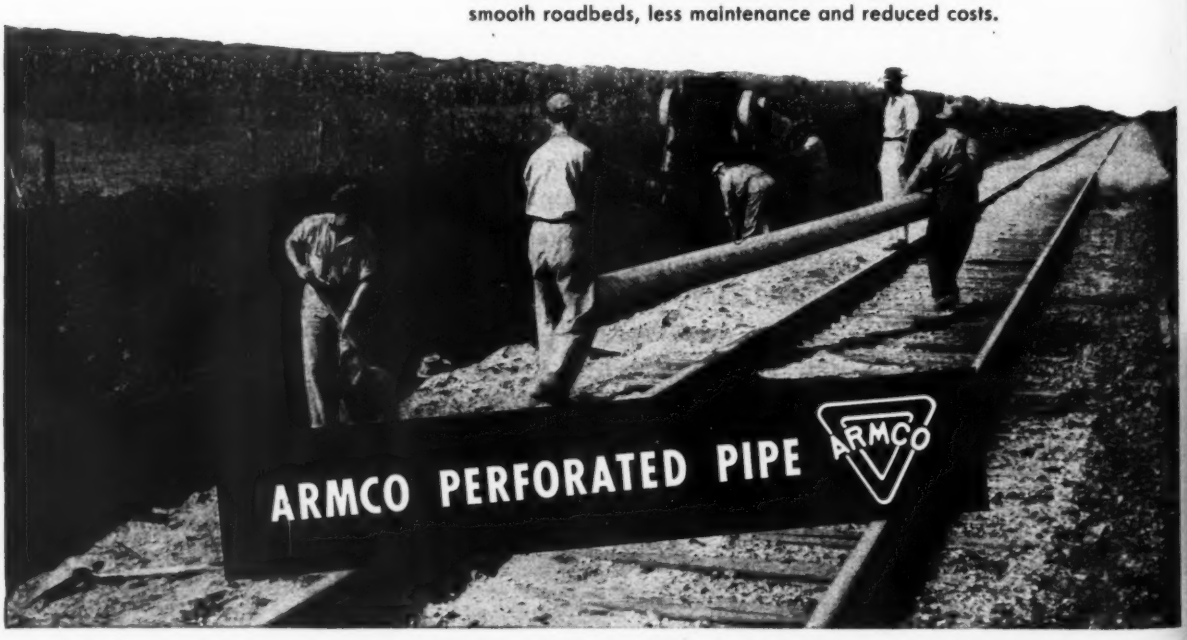
Here is a plan of attack that routes sub-surface water, arch-enemy of good roadbeds, and keeps "him" on the run. It is simple and sure. Just drain the water out and keep it out. You can do this with ARMCO Perforated Pipe.

You'll find ARMCO Pipe has many advantages for installing complete railroad subdrainage systems, or for patching up trouble wherever it occurs. This pipe is light in weight for low-cost hauling and handling. Long lengths, tightly joined with band couplers, are easily and quickly installed by unskilled workmen. The job moves fast and installation costs are low.

Breakage is no problem either. Your subdrainage system has *proved strength* to resist crushing, cracking or disjointing under the impact and weight of heavy loads. Shifting soils and severe frost action have no effect on ARMCO Pipe.

For a smooth track and good roadbed you need a firm, dry foundation. ARMCO Perforated Pipe will give it to you. It stabilizes subgrades, reduces annual maintenance expense, insures freedom from failure. Write for data. Armco Drainage & Metal Products, Inc., 1625 Curtis St., Middletown, O.

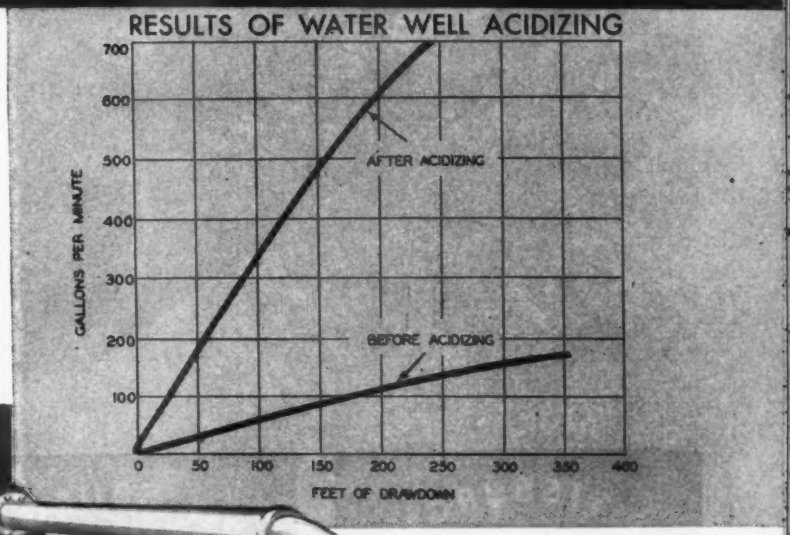
You can "outlaw" slow orders and costly maintenance by installing ARMCO Perforated Pipe. It pays off in firm, smooth roadbeds, less maintenance and reduced costs.

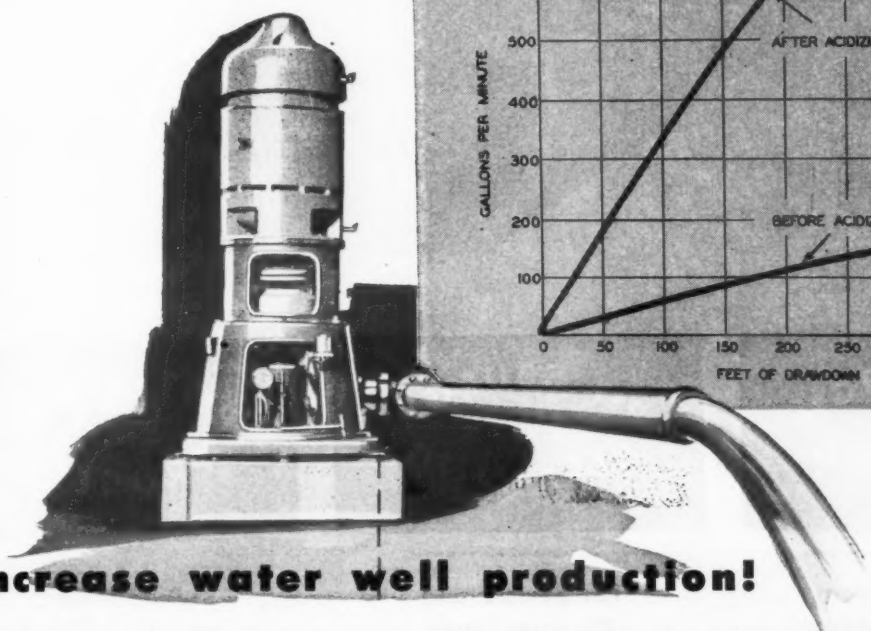


DOWELL

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

...down Curves showing the advantages which have been ...ined from proper chemical treating of water wells.





increase water well production!

Treatment results, in Dowell files, list the many production increases which have been secured through the proper chemical treatment of water wells. The enlargement of formation pores and the removal of retarding incrustations on screens, tubing and pump equipment permit the production of more water—faster!

Dowell pioneered in the well-acidizing field and its engineers have the know-how based on years of experience gained in treating thousands of oil, gas and water wells. Well operators rely on Dowell to perform the entire treatment—to select the proper liquid solvents, bring them to the well site, and pump them into the well.

Dowell service engineers use special truck-mounted tanks, mixers, pumps and control equipment. Call the nearest Dowell office for a free estimate.

NOTE: Special Dowell inhibitors protect metal well equipment during the treatment. Tasteless, odorless, nontoxic inhibitors are used in wells producing water for domestic and commercial consumption.

DOWELL INCORPORATED, TULSA 3, OKLAHOMA

New York, Boston, Philadelphia, Wilmington, Baltimore, Pittsburgh, Buffalo, Cleveland, Cincinnati, Detroit, Chicago, St. Louis, Kansas City, Wichita, Oklahoma City, Houston, Fort Worth, Shreveport, Mt. Pleasant, Michigan; Salem, Ill.; Borger, Texas; Wichita Falls, Texas; Midland, Texas; Lafayette, La.; Hattiesburg, Mississippi. Long Beach, Casper: Dowell Associate—International Cementers, Inc.

Dowell service is supervised by trained engineers using carefully selected liquid solvents and special mobile equipment.

DOWELL

FOR INDUSTRIAL CHEMICAL SERVICE

PITTSBURGH PIPE CLEANING

For Water, Steam & Fuel Supply Lines 3″ to 72″ I.D.

Specialized equipment, employing hydraulic and mechanical methods, together with the "know-how" gained from thousands of tough pipe cleaning jobs, is your assurance that water supply lines can be THOROUGHLY cleaned! All incrustation, tuberculation and LARGE OBJECTS lodged in lines are removed to restore water systems to top capacity. Think of what this means in reduced pumping pressure, lower pumping costs, faster water servicing and increased fire protection: It pays to have pipes cleaned the Pittsburgh way!

PITTSBURGH SEWER CLEANING

For Sewers and Disposal Lines 8″ to 10 ft. I.D.

Good drainage is a prerequisite of good track and efficient yard maintenance. That is why so many railroads rely on Pittsburgh Sewer Cleaning Service to keep their drainage systems at top capacity. Pittsburgh's experts have the specialized equipment and technical knowledge to take care of your toughest sewer cleaning problems . . . at minimum cost and without delay. A floor or a freshet may occur tomorrow. Make certain that your drainage system can take care of it TODAY!

PITTSBURGH ERIC PROCESS

Pipe Lining for Water Mains 3″ to 24″ I.D.

Specify Pittsburgh-Eric Process on your next pipe cleaning job! After thorough cleaning, the pipe is lined with LECTUMEN which imparts a smooth, long-lasting trouble-proof coating to steel and C.I. water mains. LECTUMEN not only protects the pipe from underlying deterioration, but resists the accumulation of organic deposit within the main. The result is many additional years of service from existing mains at a fraction of the cost of replacement.

PITTSBURGH PIPE CLEANER COMPANY

133 Dahlem St., Pittsburgh 6, Pa.

PHILADELPHIA · BALTIMORE · WASHINGTON · NEW YORK · BUFFALO · CHICAGO · CINCINNATI · ST. LOUIS · DETROIT · BOSTON

TWO P&H ELECTRODES that Can Do 90% OF YOUR WELDING

DEPENDABLE ARC WELDING SERVICE FOR RAILROADS BY RAILROAD WELDING SPECIALISTS

Here's a sure way to important savings: two P&H Welding Electrodes of such wide usefulness, they can do all your mild steel welding.

These are two P&H Electrodes *especially* suited for railroad welding — "PF" and "AP". They can mean an end to the stocking of dozens of types — and the ensuing high costs, waste and elaborate procedures. "PF" and "AP" are excellent for maintenance and repair work . . . for car and other fabrication. They provide faster, surer welding of both — for substantial savings in each.

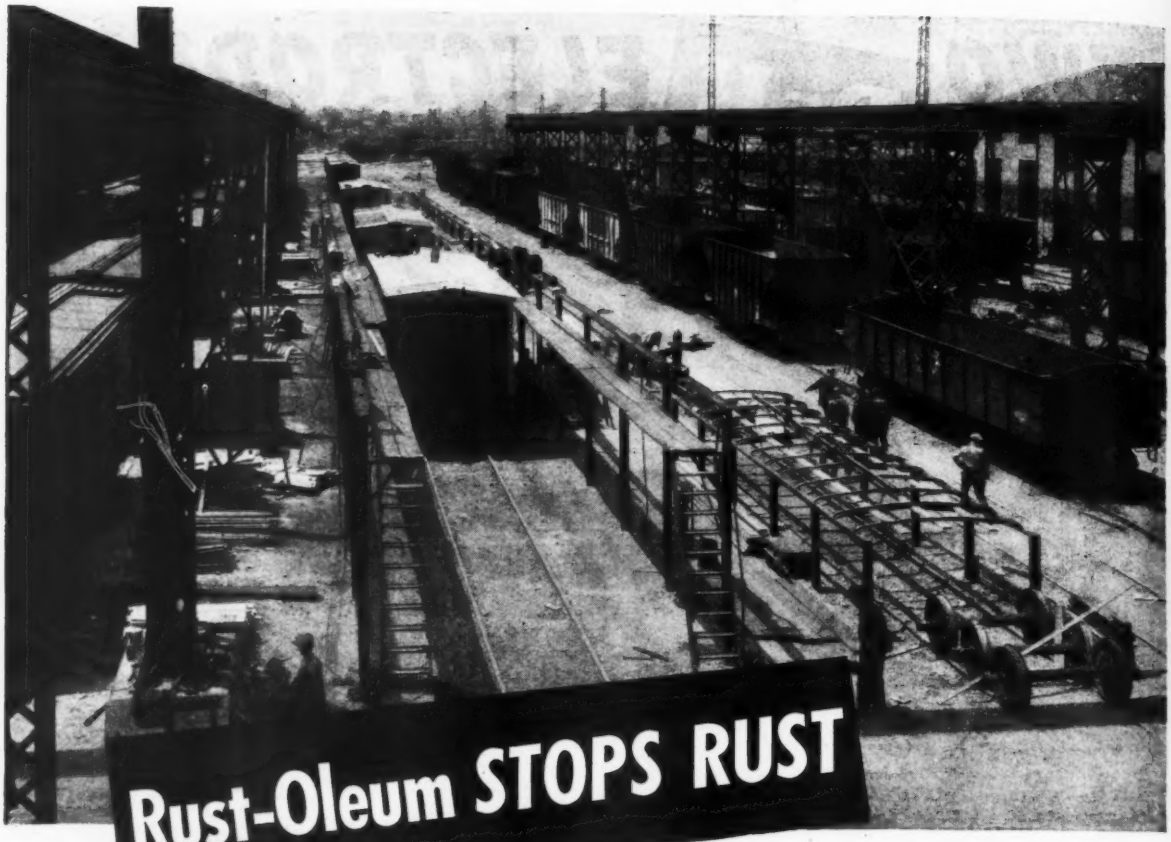
Many progressive roads are using these two P&H Electrodes for as much as 90% of their mild steel welding. You, too, can have this unusual welding service. Why not talk to a P&H Railroad Sales Representative about "PF" and "AP"? Call or write today.

For that other 10% welding — there is a P&H Electrode — AC or DC — for welding all mild, alloy and stainless steels, and cast iron. Also types for building up and hard surfacing.

P&H Model WA-200 Arc Welder for shop work, Welding Service Range to 285 amperes. Other AC and DC models to meet all average requirements. Also skid and wheel mounted for all railroad needs.

P&H RAILROAD SALES DIVISION
4606 West National Avenue
Milwaukee 14, Wisconsin

HARNISCHFEGER CORPORATION
WELDING ELECTRODES · MOTORS · HOISTS · P&H · ELECTRIC CRANES · ARC WELDERS · EXCAVATORS



Rust-Oleum STOPS RUST

. . . . . IT KEEPS CARS ROLLING LONGER!

CHECK THESE 3-WAY SAVINGS

1. **IT CUTS PREPARATION TIME!** No sand blasting or chemical cleaners are necessary. Merely wirebrush to remove paint scale, blisters, etc.
2. **IT GOES ON FASTER!** Rust-Oleum saves 25% of the time ordinarily required for application of ordinary materials . . . and covers 30% more area.
3. **IT LASTS LONGER!** Rust-Oleum's protective coating outlasts paint two to ten times—according to exisiting conditions.

EASY TO USE . . . LASTING PROTECTION

APPLY BY BRUSH, DIP OR SPRAY

Add years of useful life to every car—*new or old*—by safeguarding it with Rust-Oleum. *Rust-Oleum provides lasting, low-cost protection.* It coats metal with a tough, water-tight, *enduring* film that prevents rust caused by moisture, fumes, acids, heat and other destructive elements found in railroad operation.

As a *proved* rust preventive, Rust-Oleum cuts maintenance cost sharply. Rust-Oleum outlasts ordinary protective materials two to ten times—according to conditions. Specify it on all re-building jobs . . . and cars will require less frequent overhauls. Rust-Oleum prevents rust on *hidden surfaces* subject to condensation through temperature changes.

Get the facts now! Write today for Catalog No. 145 for full information and recommended railroad applications.

RUST-OLEUM CORPORATION

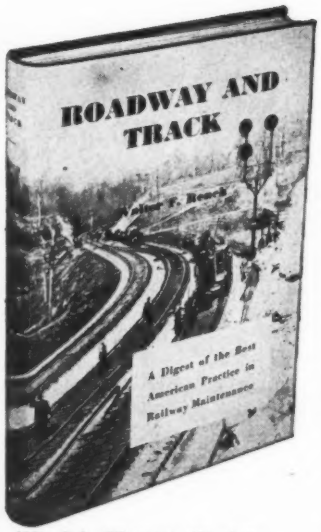
2417 OAKTON STREET • EVANSTON, ILLINOIS

New Third Edition

ROADWAY AND TRACK

By Walter F. Rench

Formerly Supervisor on the Pennsylvania Railroad;
Author of *Simplified Curve and Switch Work*



1946. 3rd. 350 pages, 101 photographs, 19 line drawings, 12 tables, index, 6 x 9, cloth, $5.00

The new edition features the use of the latest mechanical equipment in connection with roadway and track maintenance. Older methods employed where full mechanical equipment is not available are also explained. While most of the methods described are those which are standard on the *Pennsylvania,* A.R.E.A. recommended practices and those in use on other well maintained roads have also been included.

Outstanding types of mechanical equipment used in track work are described and illustrated with action photographs. Engineering drawings show working details. The economies resulting from the adoption of modern methods are clearly outlined. Useful tables have been added to make the book suitable for reference use, as well as a practical handbook on modern methods.

For Track Supervisors

While written primarily to serve the needs of track supervisors and other maintenance officers, the new edition contains material of considerable interest to transportation and mechanical officers who require a working knowledge of the fundamentals of maintenance of way practice. Section and extra-gang foremen, who wish to acquire a broader knowledge of their work and of methods used elsewhere, will find the book helpful.

CONTENTS

Part I—ROADWAY: Essential Elements in Roadway Maintenance—The Right of Way—Drainage of Roadbed and Track—Vegetation for Banks—Economics of Roadway Machines—Labor Saving Methods and Devices in Roadway Work—Small Tools and Their Uses.

Part II—TRACK: Essential Elements in Maintenance of Track—Program for Maintenance of Way and Structures Work—The Track Obstruction—Power Machines and Equipment—Labor Saving Methods in Track Work—Track Materials and Their Uses—Practice in Rail Renewals—Practice in Rail Repair and Inspection—Maintenance of Main Tracks—Maintenance of Yards and Terminals.

Part III—SPECIAL PROBLEMS AND DUTIES: Maintenance Problems and Methods Used—Economics of Track Labor—Special Duties in the Maintenance of Way Department.

Send For Your Copy Today

To obtain one of the first copies send in your order today. Give it a ten day examination. If it is not the track book you have been looking for you can mail it back.

—Ten Days Free Examination Coupon—

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30 Church Street, New York 7, N. Y.

Please send me on Ten Days Free Examination a copy of the Third Edition of ROADWAY AND TRACK by Walter F. Rench. If satisfactory, I will remit the list price of $5.00. Otherwise, I will mail the book back postpaid, without obligation.

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City ..... **State** .....

Company ..... **Position** .....

R. E. & M. 11-47

2 Ways RED LEAD NEUTRALIZES ACIDS ...Retards Rusting

Those responsible for making metal last have long accepted Red Lead as the "standard" metal protective paint.

Now scientific research discloses sound reasons why Red Lead gives plus protection. For example, one important factor is Red Lead's ability to counteract the acid conditions which accelerate rusting.

Red Lead accomplishes this in two ways.

1. Red Lead Counteracts Environmental Acids: The uses to which structural steel is put normally expose it to acid environments. For one thing, it is usually subjected to the attacks of industrial gases and smoke. Certain of these, in contact with moisture, produce acid-forming compounds that speed up rusting. Then, too, pollution of waterways also results in acidity. Red Lead effectively neutralizes all such acids, and thus counteracts their rust-accelerating effect.

2. Red Lead Controls Inherent Acids: Many paint vehicles, such as linseed oil, synthetic resin varnishes and other commonly used types, *themselves* produce organic acids during the natural process of ageing. Many of these inherent acids, too, hasten corrosion. However, when Red Lead is the pigment in a metal protective paint, this rust-causing acidity is kept in check. Thus, a "controlled" acid level is maintained in the paint film. This is a singular property of Red Lead and contributes greatly to its film flexibility, impermeability and long life.

* * *

Remember that Red Lead is compatible with practically all vehicles commonly used in metal protective paints, including many of the fast-drying resin types.

Specify RED LEAD for ALL Metal Protective Paints

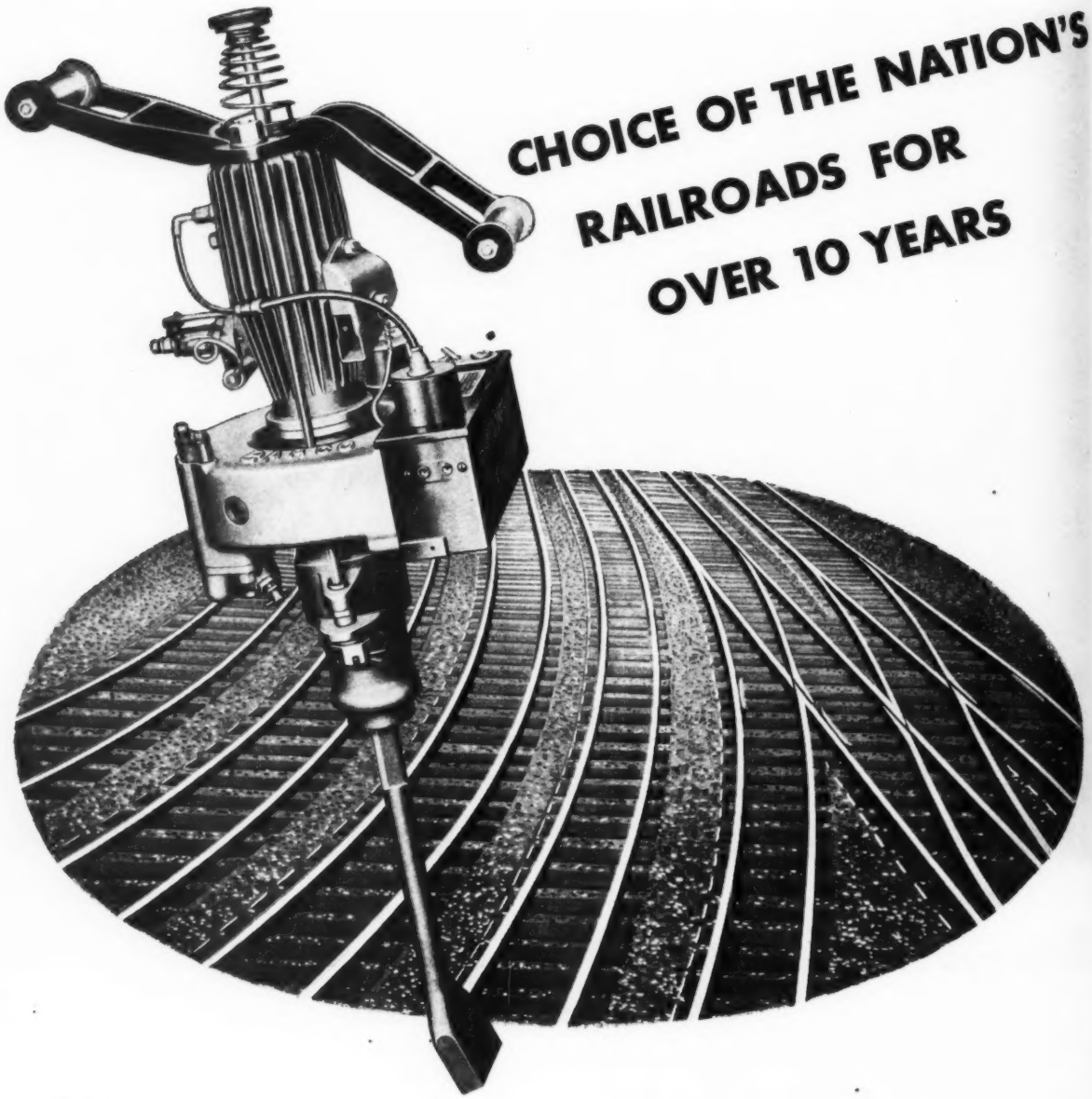
The rust-resistant properties of Red Lead are so pronounced that it improves any metal protective paint. So, no matter what price you pay, you'll get a better paint if it contains Red Lead.

* * *

The benefit of our extensive experience with metal protective paints for both underwater and atmospheric use is available through our technical staff.

NATIONAL LEAD COMPANY: New York 6; Buffalo 3; Chicago 8; Cincinnati 3; Cleveland 13; St. Louis 1; San Francisco 10; Boston 6, (National Lead Co. of Mass.); Philadelphia 7, (John T. Lewis & Bros. Co.); Pittsburgh 30, (National Lead Co. of Pa.); Charleston 25, W. Va., (Evans Lead Division).

DUTCH BOY
Reg. U.S. Pat. Off.
RED LEAD



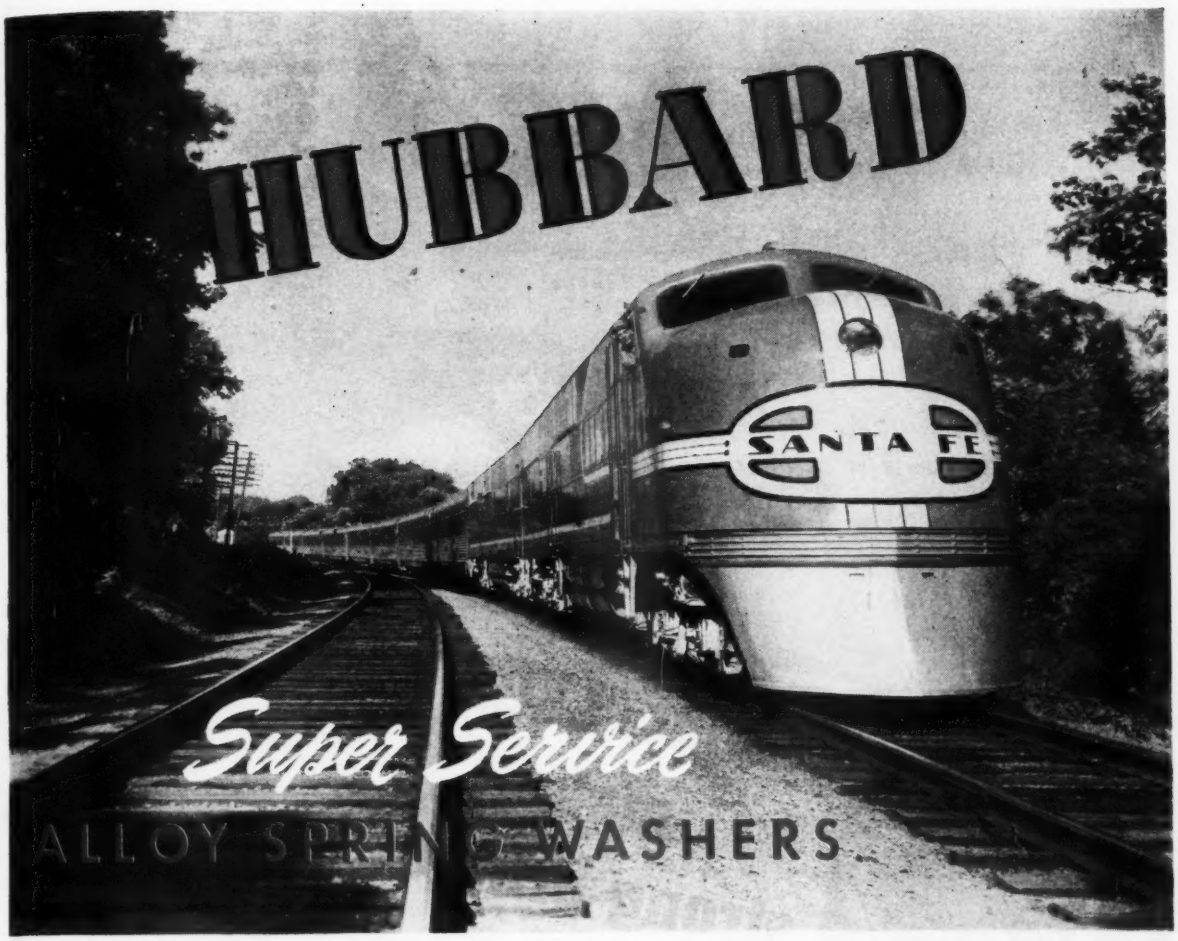
CHOICE OF THE NATION'S RAILROADS FOR OVER 10 YEARS

EACH of the last ten years has seen more and more of America's railroads select Barco. Today, over 100 of them use Barco for spot or gang tamping, cribbing, breaking, drilling, and winter ice service. Each of the thousands of Barco Tytampers now in use is self-contained, rugged, and versatile—with just the right weight to give the heaviest blows without requiring greater effort on the part of the operator. For more information on this popular, time-proven tool, write to Barco Manufacturing Company, Not Inc., 1805 Winnemac Avenue, Chicago 40, Illinois.

BARCO

UNIT TYTAMPERS

Free Enterprise—the Cornerstone of American Prosperity



Surplus Reactive Pressure is the key to economy of Hubbard SUPER SERVICE Spring Washers. They deliver 130% more reactive pressure than required in A.R.E.A. Specifications.

Put them to work on main line track, turnouts, frogs and crossings, and rail and joint maintenance costs will go down.

HUBBARD and COMPANY
Tool Division
Manufacturers of Quality Railroad Track Tools
Alloy Spring Washers and Rail Anchors
6301 Butler Street
Pittsburgh (1), Pennsylvania

Built by Board of County Commissioners, Dade Co., Fla., Earle M. Rader, County Engineer. J. E. Greiner Co., Consulting Engineers.

ON THE RICKENBACKER CAUSEWAY

AGAIN Monotubes play an important part in an engineering triumph—the Rickenbacker Causeway, Miami, Fla.

1260 7-gauge Monotube tapered steel piles, 45′ long, with 18″ butt diameter, were used in the piers of the fixed-beam bridges for this project. Piles were capped at the water line.

For this job, as on so many others, Monotubes were chosen because of their time-and-money-saving advantages. *They are cold-rolled and fluted for extra strength,* resist bending forces equally well from all directions. *They're light in weight, easily handled, extendible right on the job. Tapered design speeds driving—tubular construction makes inspection easy before concreting.*

For complete information, write The Union Metal Manufacturing Co., Canton 5, Ohio.

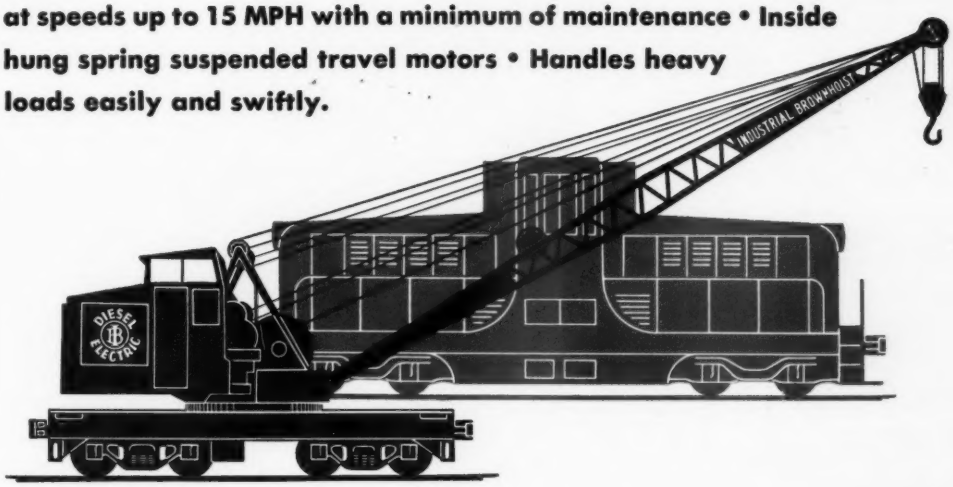
UNION METAL

Monotube Tapered Piles

NOW AVAILABLE . . . BROWNHOIST DIESEL-ELECTRIC LOCOMOTIVE CRANE

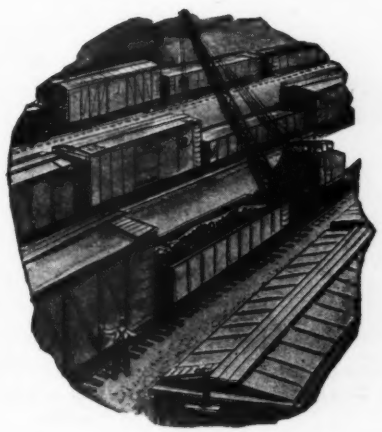
(PATENT APPLIED FOR)

Versatile new BROWNHOIST CRANE doubles as switch engine • Travels at speeds up to 15 MPH with a minimum of maintenance • Inside hung spring suspended travel motors • Handles heavy loads easily and swiftly.

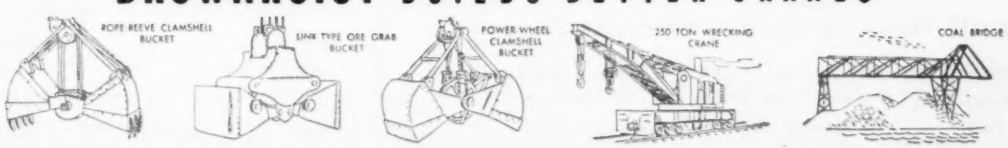


You get *double duty* from the new Brownhoist Diesel-Electric Locomotive crane . . . a heavy duty switch engine that *operates at minimum cost!* A powerful, rugged unit built to absorb shock and strain day after day. Switching in your yards with low fuel and maintenance costs. No soot or coal dust. Rapid acceleration. Electric swing available at additional cost. You get all this plus . . .

Low-cost CRANE operation. The patented monitor-type cab with its 360° visibility assuring greater safety, less operator fatigue, more materials handled per man hour. *Other safety features* include worm-driven boom-hoist and 14" clearance between car body and revolving upperworks. In the new Brownhoist Diesel-Electric crane you get all the many engineering and construction advantages that have made Brownhoist cranes the top choice in industry. *Write now for complete particulars* about this up-to-the-minute crane and car-switching unit.

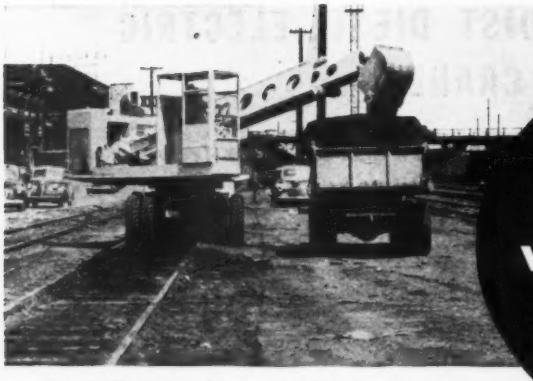


BROWNHOIST BUILDS BETTER CRANES



INDUSTRIAL BROWNHOIST CORPORATION • BAY CITY, MICHIGAN

DISTRICT OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO • AGENCIES: DETROIT, BIRMINGHAM, HOUSTON, DENVER, LOS ANGELES, SAN FRANCISCO, SEATTLE, VANCOUVER, B. C., WINNIPEG, CANADIAN BROWNHOIST LTD., MONTREAL, QUEBEC.



Imagine doing this job with any other machine than a GRADALL

Gradall does a fast, neat job in cleaning up and loading cinders which constantly accumulate between and outside the rails.

Gradall's remarkable "Arm Action" packs plenty of power and provides, for the operator, amazing accuracy and precision that avoids any damage to rails, ties or tie plates.

A change of tools, requiring less than 15 minutes, and Gradall is at work making a neat drainage ditch between tracks.

One machine—
does all these railroad maintenance jobs

- Trench Digging
- Widening Cuts and Fills
- Restoring Embankments
- Cleaning Tracks and Road Beds
- Sloping and Grading
- Back Filling
- Ripping and Loading Old Pavement
- Excavating
- Snow Removal and Loading

AS THESE PICTURES SHOW, a Gradall can "go places and do things" no *one* other earth handling machine can do!

Cleaning cinders from track and between ties is customarily a manual job—laborious and time taking. The multi-purpose Gradall with its unique "Arm Action" makes it possible to do this tricky job by machine—doing it cleaner and safer than with any conventional equipment—doing it faster and far cheaper than by hand.

Gradall versatility, positive control, and full hydraulic action, make it an ideal machine for railroad maintenance service. It needs scant head room, so it works under low hanging wires and ceilings. It works well in close quarters around poles, signal standards and bases. Interchangeable tools for many different jobs are available in standard and special designs.

Get all the facts about Gradall . . . Write Warner & Swasey, Cleveland 3, Ohio.

Gradall Reg. U. S. Pat. Off.

GRADALL DIVISION
WARNER & SWASEY
Cleveland

WARNER & SWASEY
Cleveland 3, Ohio

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Name .....

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20% of your railroad profits came from using Pressure-Treated Wood

Here's a true story from real life. A railroad official is showing his company's annual statement to a Koppers executive.

"We made a profit last year," he says, "in spite of all the money we gave you boys for pressure-treating wood."

"In SPITE of it," retorts the Koppers man, "BECAUSE of it, you mean! Look—railroad 10-year records show every treated tie saves an average of almost 9 cents per year. With approximately a billion ties in maintained track, average annual savings are $88,500,000. That's more than 20% of the average net returns from '37 to '46. This saving is on TREATED TIES ALONE . . . doesn't include the added millions saved by pressure-treated piles, posts, bridges, crossings, platforms, buildings and car lumber.

"And remember . . . the possibilities for extra savings and extra profits from using these items haven't even been scratched!"

HAVE YOU CHECKED THESE ADDED SAVINGS POSSIBILITIES FOR YOUR ROAD?

BRIDGES. Savings of over 40% have been reported from pressure-treated trestles as compared to other permanent types of construction.

BUILDINGS. Pressure-treated floors, frames and roofs show greatly increased life, lowered cost, over untreated materials.

PLATFORMS. Pressure-treatment halts the decay that is the cause of many so-called "mechanical" failures . . . saves expensive repairs and replacements.

TANKS. On one road, a test installation of a pressure-treated wood tank was so successful that 165 additional tanks have since been built.

OTHER APPLICATIONS. Average life and overall economy of crossings, poles, posts, and other members are greatly increased by pressure-treatment.

With maintenance costs mounting, the possible dollar savings from added life is greater now than ever. Ask for Bulletin G-23.

K KOPPERS

PRESSURE-TREATED WOOD

KOPPERS COMPANY, INC.

PITTSBURGH 19, PENNSYLVANIA

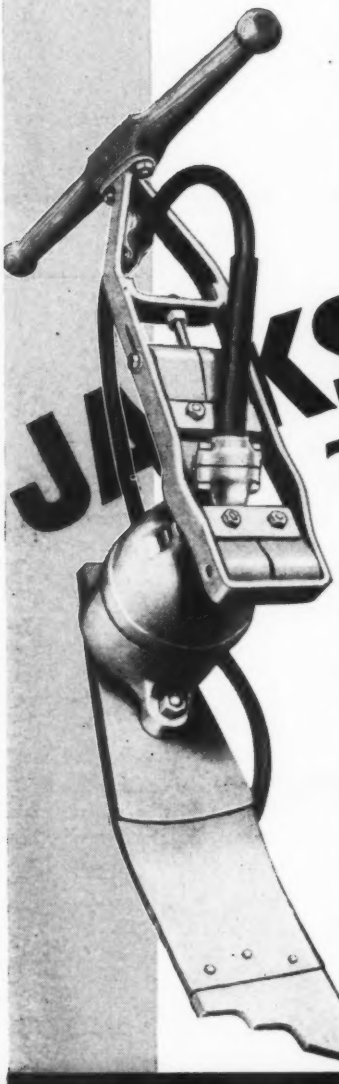
25 YEARS OF DEMONSTRATED SUPERIORITY

For over 25 years Jackson Vibratory Tamping Equipment has been sold by actually *demonstrating* on the job its ability to do more and better work than is possible with any other equipment!

As a result, today, close to 90% of all leading roads use Jackson Equipment for both spot tamping and major ballast placing operations, and far, More Jackson Tie Tampers are in daily use than the aggregate of all other mechanical tampers.

Three major facts are responsible for this overwhelming popularity: 1. The vibratory action of Jackson Tie Tampers gives you a more closely-fitted, lastingly-firm roadbed requiring less future maintenance. 2. The speed with which they perform the work effects a radical reduction in labor costs. 3. They're absolutely reliable, and with ordinary care, the upkeep factor is practically negligible.

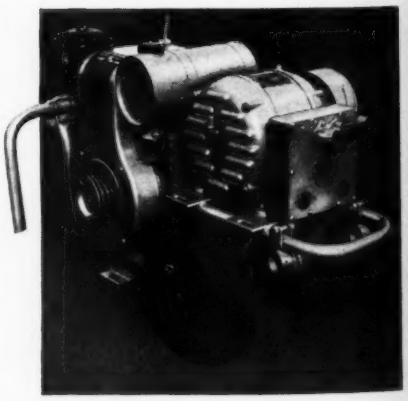
These are facts that the Jackson field engineer in your district will gladly *demonstrate* (not just tell you about)! Drop us a line.



JACKSON VIBRATORY TIE TAMPING EQUIPMENT

B & B MEN: The same Jackson Portable Power Plants employed for operating 4, 8 and 12 Tampers, are ideal for operating power tools, lights, etc. They are husky, reliable, always ready to deliver 24 hour service. Equipped with permanent magnet generators which require no adjustment or maintenance. They supply both single-phase and 3-phase, 60 cycle, 110 volt AC and are available in capacities of 1.25, 2.5 and 5 KVA. Model M-2, 2.5 KVA, shown at the right.

M—2 POWER PLANT



ELECTRIC TAMPER & EQUIPMENT CO., Ludington, Mich.

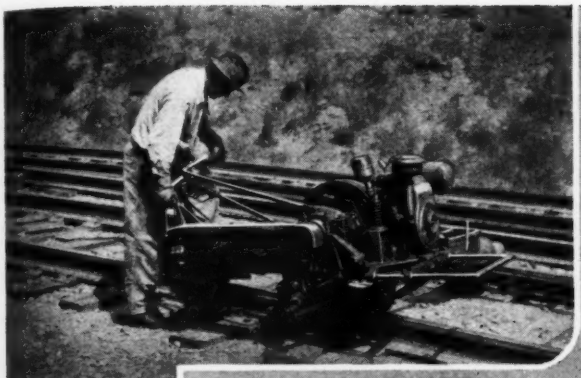
ADDITIONAL INFORMATION

On Any of the Products Mentioned in This Issue

Below is a complete index of the products referred to in both the editorial and advertising pages of this issue. If you desire additional information on any of them, use one of the accompanying addressed and stamped postcards in requesting it. In each case give name of product and page number. The information will come to you directly from the manufacturer involved, without any obligation on your part.

Products Index

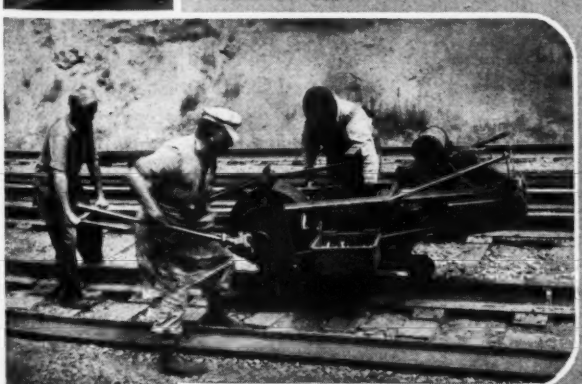
10 NORDBERG MACHINES
MECHANIZE THIS RAIL LAYING GANG



LOOSENING TRACK BOLTS

PULLING SPIKES

ADZING TIES



DRIVING SPIKES

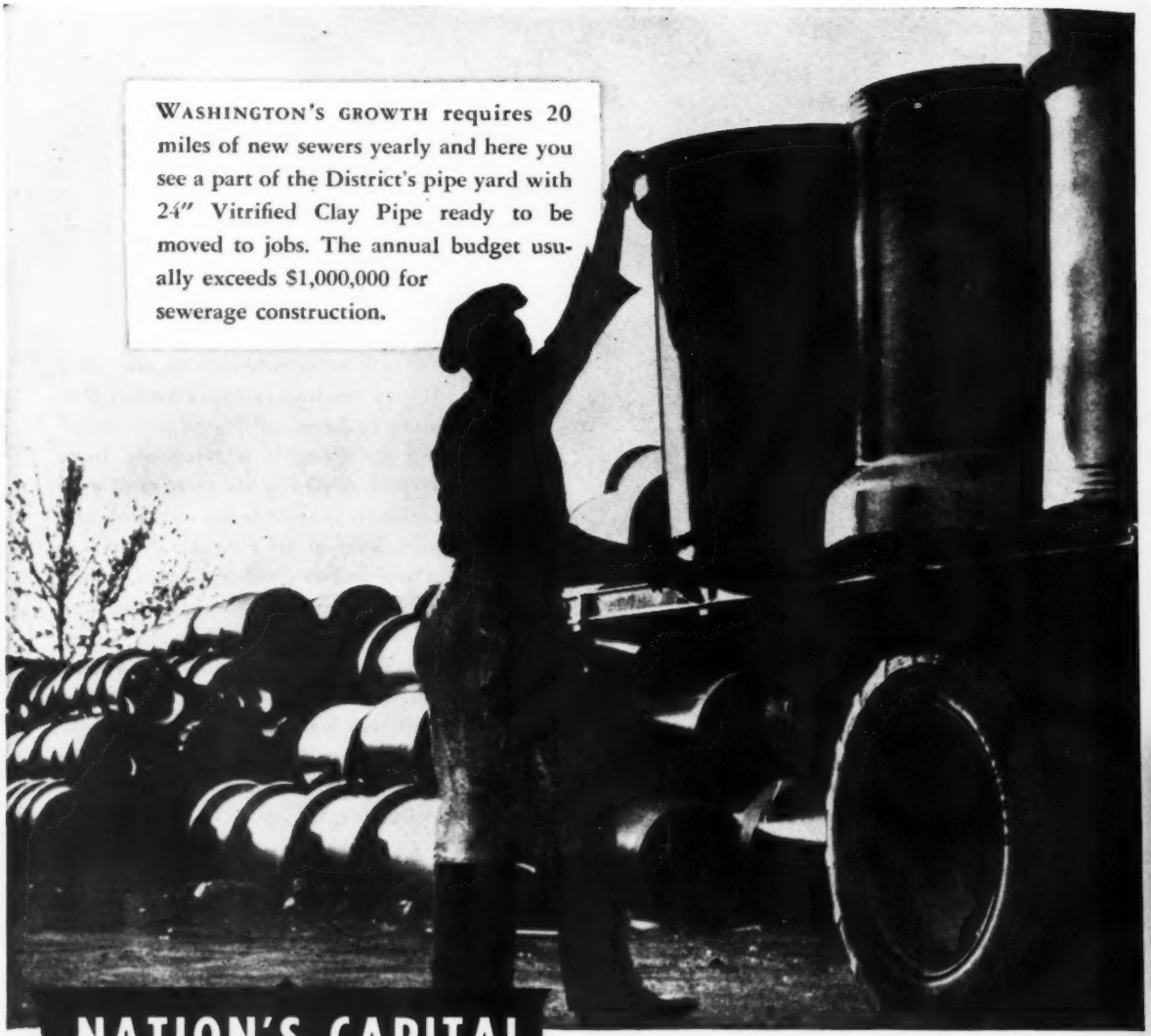
Track machinery built by Nordberg is very much in evidence on this Milwaukee Road rail laying job. Heading the gang is a Nordberg Track Wrench requiring the services of only one man to remove the nuts from the track bolts of the old rail. This is followed by two Nordberg Spike Pullers and then three Nordberg Adzing Machines. Another Track Wrench uniformly tightens the joints of the new rail. The spiking is done by six men with two Nordberg Spike Hammers. A Nordberg Rail Drill is also available for closing and for switch installations.

Like other similarly Nordberg mechanized gangs, one operation closely follows the other. The old rail is quickly removed and tie seats prepared for the new rail. Spiking is always just behind the rail crane. This is not a long drawn out operation as is so often the case with hand driving. ***For speed and low cost rail laying, Nordberg machines are essential in these days of labor shortage.***

NORDBERG
MFG. CO.
MILWAUKEE 7, WISCONSIN

NORDBERG MACHINES
of your track maintenance

ADZING MACHINE	SURFACE GRINDER
SPIKE PULLER	UTILITY GRINDER
TRACK WRENCH	MIDGET GRINDER
RAIL DRILL	FLEXIBLE ARM GRINDER
CRIBEX	TRACK SHIFTER



WASHINGTON'S GROWTH requires 20 miles of new sewers yearly and here you see a part of the District's pipe yard with 24" Vitrified Clay Pipe ready to be moved to jobs. The annual budget usually exceeds $1,000,000 for sewerage construction.

NATION'S CAPITAL HAS RELIED ON VITRIFIED CLAY PIPE FOR OVER 100 YEARS

WHEN OUR national capital was burned in 1814, Clay Pipe was already in use for an 18-inch sewer in Eleventh Street, N.W. Today, Washington, city of majestic buildings, beautiful parks, broad avenues; center of culture, study and research; still relies on Clay Pipe.

And Washington sets the standard for the use of Vitrified Clay Pipe throughout the nation.

Engineers rely on Clay Pipe because it does not rust, corrode or crumble. It never wears out, thus assuring service long after the project's cost has been retired.

WRITE FOR INFORMATION on *your* Clay Pipe problem.

NATIONAL CLAY PIPE MANUFACTURERS, INC.

703 Ninth and Hill Bldg., Los Angeles 15, Calif.
522 First National Bank Bldg., Atlanta 3, Ga.
1105 Huntington Bank Bldg., Columbus 15, Ohio
111 W. Washington St., Chicago 2, Ill.

C-847-7

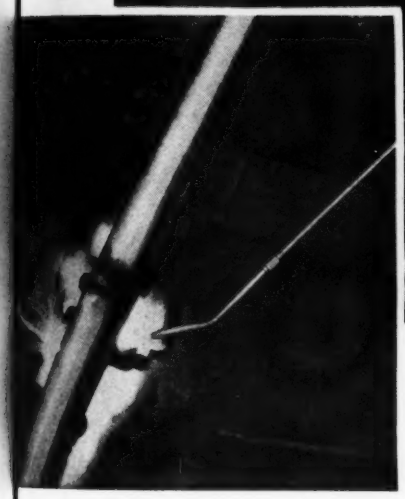
CLAY PIPE

CLAY PIPE NEVER WEARS OUT!

Avoid PERMANENT WAVES

by Flame-Straightening Joint Bars

This efficient flame-straightening setup permits operation of two blowpipes by one operator.



Using standard heating blowpipes with extension tubes, two operators simultaneously flame-straighten both bars.

Permanent waves occur in track when rail ends are held below surface by bent and worn joint bars. In most cases deformed bars can be reclaimed in track by Oxweld's flame-straightening method. The center of the bar at the junction of web and base is quickly heated to a red heat. As it cools, contraction straightens the bar and allows the sagging rail ends to return to a more nearly true surface.

This economical process for flame-straightening joint bars results in: LONGER SERVICE LIFE FOR JOINT BARS—LESS WEAR AND TEAR ON TRACK AND ROLLING STOCK—SMOOTHER RIDES FOR FREIGHT AND PASSENGERS. It also reduces the amount of welding to build up rail ends.

Each year railroads are flame-straightening thousands of joint bars by this Oxweld method. If your maintenance-of-way operations do not include this modern process, ask your Oxweld representative for details.

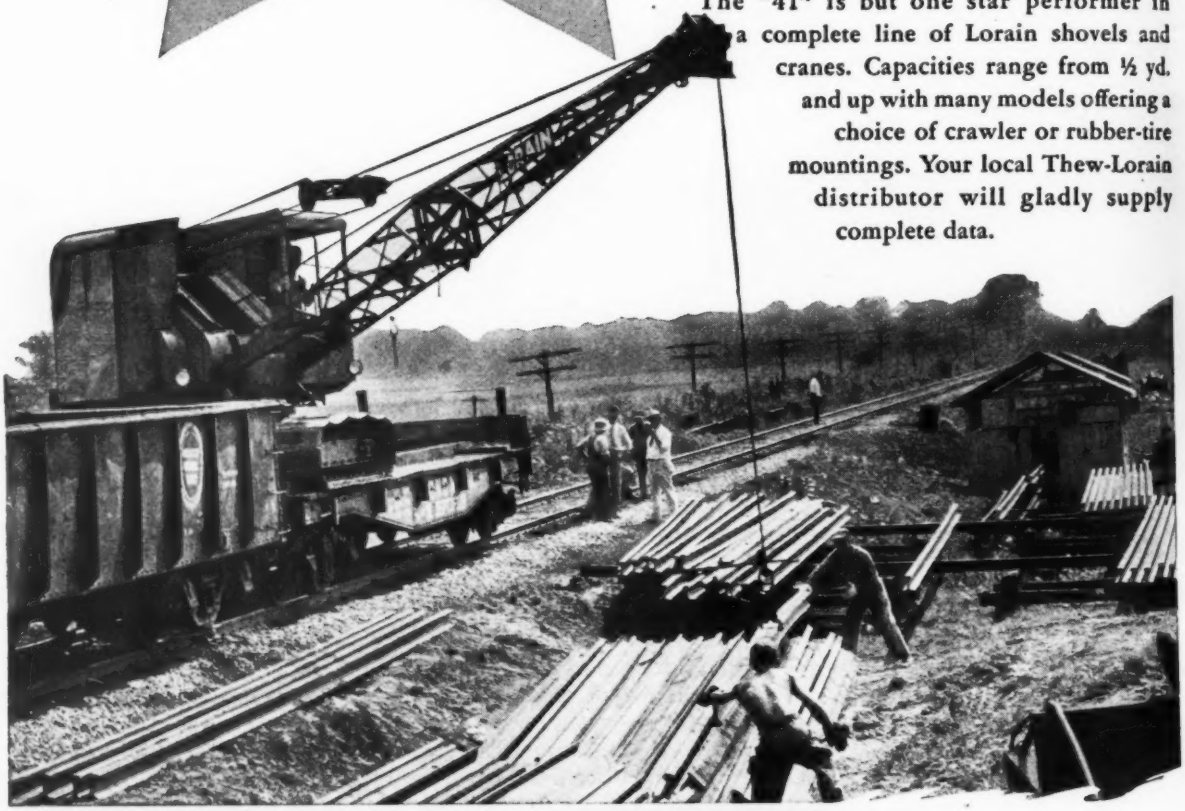
LORAIN stars on Monon R. R. track team

★ This ¾ yd. Lorain-41 is a valued member of the Monon Railroad track team which is laying new rails in welded lengths of three-quarters of a mile or more.

Here it is pictured stock piling rails in preparation for the assembly line welding process shown at the right. As a length is completed, the Lorain lifts one end into the right-of-way for towing into position by a locomotive. When the old rails are removed the crane then helps to move the new section into position.

And this is but one of the Lorain's many duties. Ability of this crawler mounted unit to work on or off-the-track or on or off-the-car as the occasion demands enables it to handle a wide variety of work in yard and along right-of-way.

The "41" is but one star performer in a complete line of Lorain shovels and cranes. Capacities range from ½ yd. and up with many models offering a choice of crawler or rubber-tire mountings. Your local Thew-Lorain distributor will gladly supply complete data.



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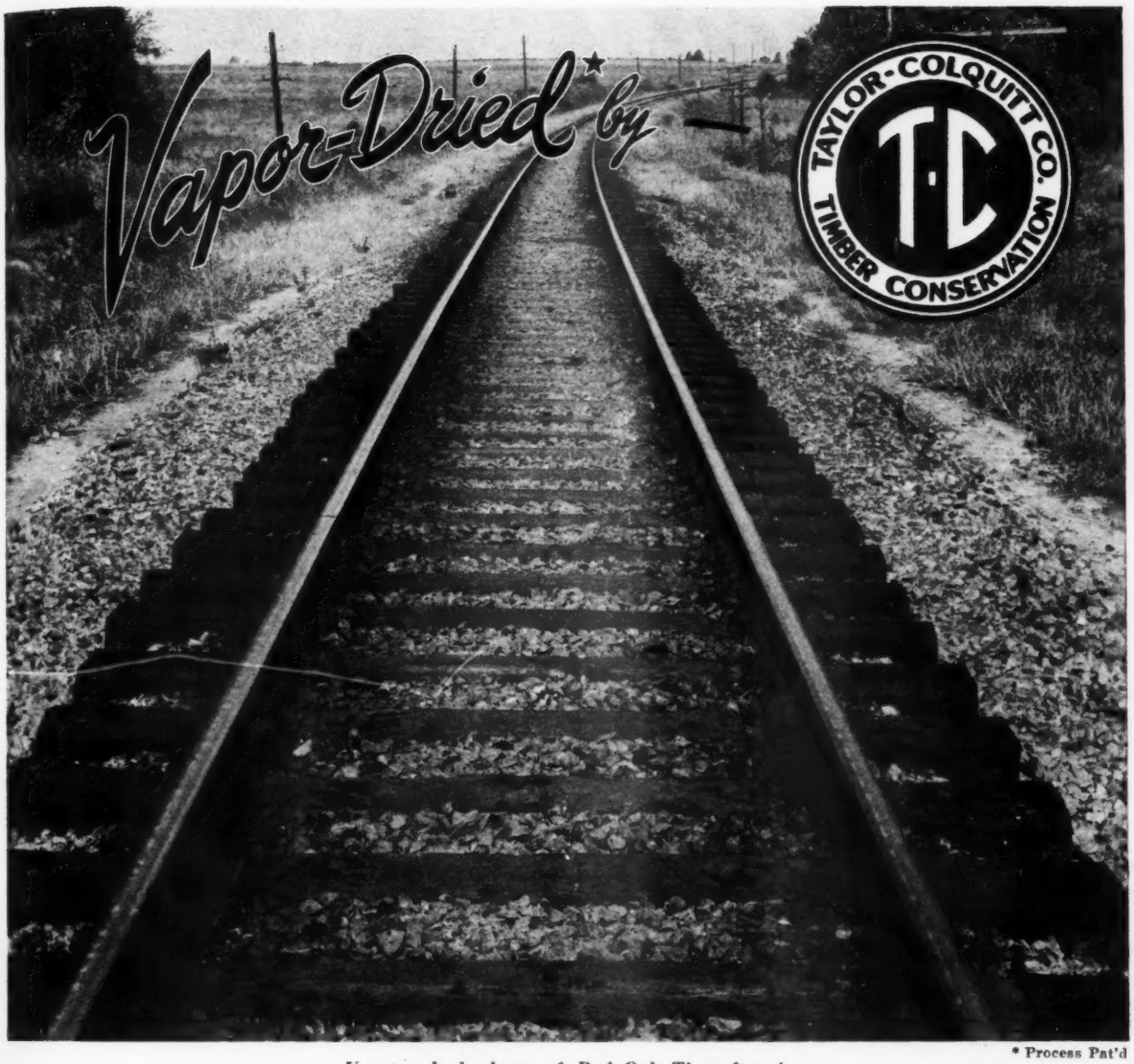

* Process Pat'd

Unretouched photo of Red Oak Ties after 4 years service—Note absence of checks and splits

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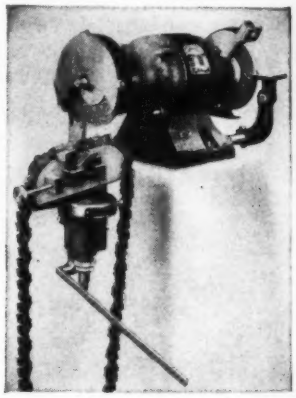

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No. 227 of a Series

Railway
Engineering and Maintenance
SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 WEST ADAMS ST.
CHICAGO 3, ILL.

Subject: Getting the Most Out of MAINTENANCE

November 1, 1947

Dear Readers:

We of the staff of Railway Engineering and Maintenance get a lot of satisfaction in putting out a magazine that is of real interest and benefit to you in your work, and the many favorable letters and comments we have received relative to our October—Roadmasters'—issue are deeply appreciated. Hope you will find the November issue, featuring the activities of the Bridge and Building Association convention, equally interesting and helpful.

Every issue of Railway Engineering and Maintenance, and especially these two issues, must impress you, as they do me, that our publication is no "picture magazine". It is not, because repeatedly over the years you have expressed yourselves in no uncertain terms that, along with adequate illustrations and news, you want the "how"—how problems were solved or overcome; how specific details of the work were done; how the gangs were organized; how equipment was used to advantage and most effectively; and the answers to a host of other questions.

But in following these standards of reporting, we recognize that a veritable textbook of information comes to your desk each month in our publication—sometimes, no doubt, when you are literally swamped with plans and work. Obviously, you can't stop to read the entire issue then, but may we suggest that you get the habit of so many of our readers, and immediately peruse the pages from cover to cover for those things that may be of immediate help to you, noting or checking others for your more detailed attention later.

Only recently, two readers, who to the moment hadn't found time to "read the entire issue", reported finding timely helps in advertising and text pages by a quick perusal and selective reading of an issue as soon as it "hit their desks". We know that such a practice of quickly assaying the contents of publications is followed by many busy business men and executives in their reading, and commend it to you as one way to get the most out of Railway Engineering and Maintenance, along with the more detailed reading of each issue throughout the month.

As recent as October 16, unsolicited, the vice president in charge of engineering of one of the most progressive roads in the country wrote me to "commend you and your staff on the fine work being done by Railway Engineering and Maintenance", and to say, "It is my impression the recent issues have really improved on the very high standard that this magazine has lived up to through the years." Such letters are appreciated, because we are constantly trying to make Maintenance better—and we want you to get the most out of it.

Sincerely,

Neal D. Howard

NDH:jb

Editor

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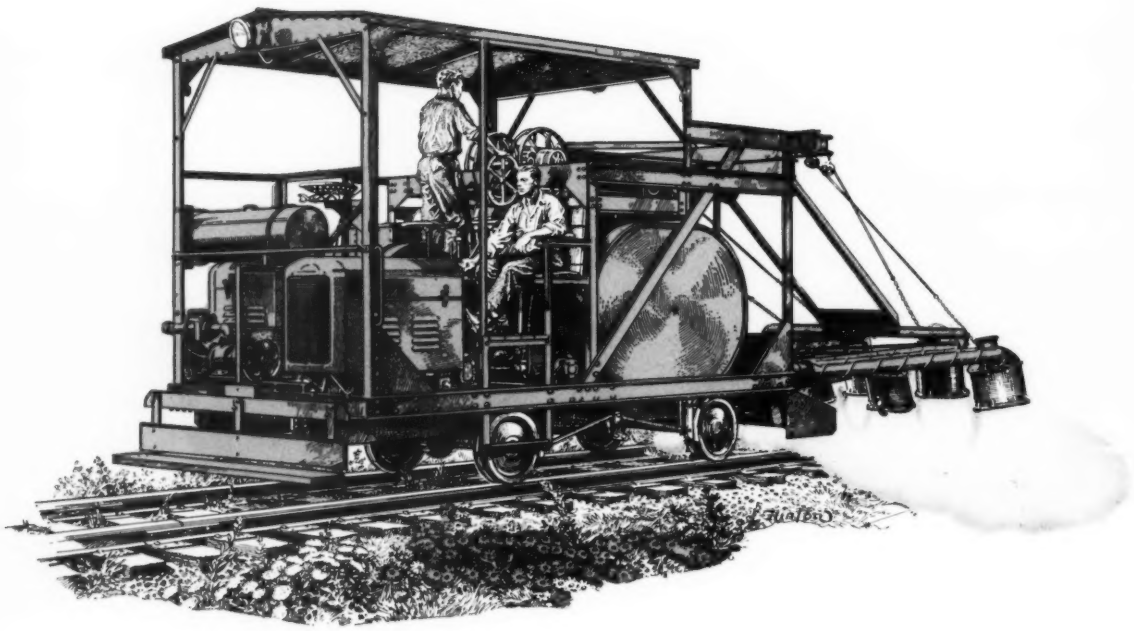

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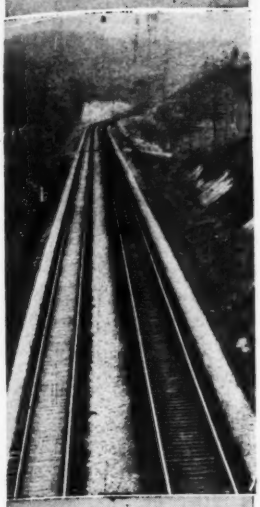

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Railway Engineering and Maintenance

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NOVEMBER, 1947

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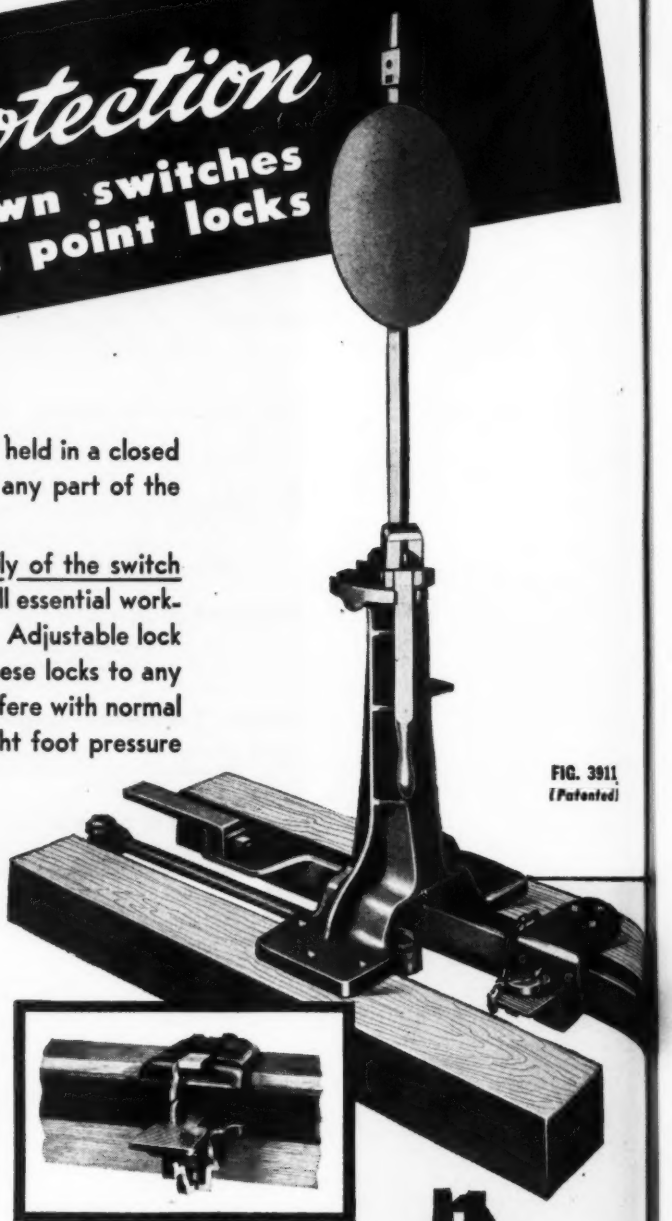
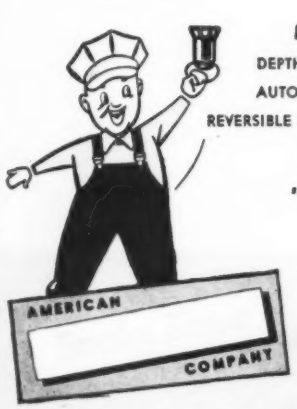


FIG. 3911
(Patented)

TWO STYLES AVAILABLE

Fig. 3911, for use with all types of column throw stands. Note how lockrod is securely engaged in lock treadle. Hand lever may also be padlocked if desired. Fig. 3912, for use with all types of ground throw switches. On this type of lock, one padlock provides positive locking of both lockrod and hand lever.

FIG. 3912
(Patented)



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Railway Engineering and Maintenance

Defeatists?

The Railroads Are Anything But—

So much has been said about the problems of the railways, especially since the war—and much in these columns—that there could be danger of creating in the minds of the public and employees a feeling that the railways are chronic complainers—defeatists—and look to others constantly for help. Nothing could be more unfortunate or unjustified. While the railways have done much complaining, they certainly are not defeatists, and if they have looked to others for help it is only because the laws of the land have put them at the mercy of certain government agencies, which at times have delayed or refused help to the point where, in justice to themselves, the railroads have had to cry out.

To mention only two sources of complaint—and who will say that complaint has not been justified—there is the government's constant and large-scale aid to the railroads' competitors—the waterways, the highways and the airways—and the delay on the part of regulatory bodies in adjusting adequately the rates the railways can charge to enable them to earn anywhere near the return necessary to their health and vigor as a private industry. No attempt will be made to air these complaints here, except to point out that, while justifiably objecting to subsidies to their competitors, the railways refuse all suggestions of subsidies to themselves, and ask to be allowed a return only sufficient to permit them to continue as a successful private enterprise, while affording the country the best, safest and most economical transportation in the world.

And, as for being defeatists, who will say that any industry, as outspoken as the railways have been in their plans for constantly improved equipment, improved fixed properties, increased safety, and ever-bettered service, has the attitude of a defeatist. There is evidence on every hand that the railways, in spite of inadequate net earnings, are implementing their determination to improve their properties and service to the public.

According to a recent statement by the Bureau of Transport Economics and Statistics of the Interstate Commerce Commission, gross capital expenditures of the Class I line-haul railroads of the country during 1947 will total $952 million, an increase of 73.1 per cent above actual 1946 expenditures of $550 million. The 1947 figure is based on reports of actual capital expenditures for the first half of the year, plus estimates furnished by the roads for the last two quarters, and includes $666 million for equipment and $286 million for roadway and structures. Thus the estimates indicate that there remained to be spent in the second half about $434 million for equipment and $167 for road. Do such expenditures smack of defeatism?

As to expenditures for *maintenance* of way and structures, and the *maintenance* of equipment, for the first seven months of the year, the facts likewise indicate anything but defeatism. During these seven months the Class I roads spent $675,104,698 for maintenance of way and structures, an increase of $8,820,418, or 1.3 per cent, compared with the $666,284,418 spent during the corresponding period of 1946. For equipment maintenance during the first seven months of 1947 expenditures totaled $883,262,449, an increase of $38,712,867, or 4.6 per cent, over the $844,549,582 spent for the same purpose in the corresponding period of 1946.

But what the railroads plan and need are still larger programs of modernization and improvements, and still higher standards of main-

tenance of both equipment and roadway. Both are essential to efficient and dependable service, and to enable them to maintain their position in a highly competitive field.

The prompt action on the part of the I.C.C. in allowing the railroads an interim increase in freight rates averaging 8.9 per cent, effective October 13, was heartening and will help do the job. But such an increase is recognized by all concerned as far from adequate. It has been estimated by the commission's Bureau of Transport Economics and Statistics that this increase will be insufficient, except in the Western district, to offset even the higher costs that will be incurred by the roads during the remainder of the year as a result of developments between June 30 and September 2, including the 15½ cents an hour wage increase awarded to non-operating employees.

Obviously, therefore, the temporary increase that has been allowed must be followed by a further substantial increase. Based on actual and foreseeable needs, the roads are asking authority to make permanent increases averaging 27 per cent. This request should receive the earliest possible approval. Not only the well-being of the railroads, but the well-being of their 1,375,000 employees, and the country as a whole, depends upon their receiving it.

Waste—

Must Be Brought Under Closer Control

THE prices of everything that is used by the maintenance of way departments of the railroads have shown sharp increases in recent years, and are still going up. Consequently, it has become more important than ever that waste be avoided in the use of materials, tools and machines.

The fact is, however, that, largely through the carelessness or negligence of employees, unnecessary losses continue to be the rule, rather than the exception. Recently a department head on a large railroad remarked that the men in a gang working on the deck of a steel viaduct on his road had, in a period of only five weeks, dropped a total of about $1,000 worth of tools into a swamp beneath the bridge, where there was no possibility of recovery. When it is considered that this loss was incurred by a single gang in only a few weeks time, there is ample reason to believe that the aggregate cost of such losses for the railroads as a whole must be enormous.

The problem, of course, is to educate the employees in the conservation of the railroads' property. The trouble is that most employees are apt to consider that the railroads are wealthy corporations and that the loss of a tool or a piece of material costing only a few dollars is of no great importance to them. To dispossess employees of this attitude will not be an easy task; it is an idea that has prevailed too long to be uprooted without a struggle.

That the Roadmasters' Association is aware of this problem is indicated by the fact that the subjects chosen for investigation by committees during the ensuing year include one entitled, Educating Track Employees in the Cost of Materials, Tools and Equipment. No doubt the committee reporting on this subject will have many constructive suggestions to offer. Unfortunately, whereas the problem is immediate and urgent, demanding action *now*, this report will not be available until September of next year.

Perhaps the best approach, if immediate results are to be achieved, would be for each maintenance officer of supervisory rank to appoint himself a committee of one with the self-assigned task of first making himself "cost conscious", and then doing everything possible to imbue the foremen and other employees under his jurisdiction with the same attitude.

High Wages—

Point to Need for Reducing Lost Time

A RAILROAD man who has been doing a lot of thinking about the present cost of track maintenance says it now costs a railroad five cents every time one of its track laborers stops to light his pipe. This figure may or may not be correct, but it is known that, as a result of the higher wage rates prevailing today, *any* idleness on the part of maintenance employees during working hours, for any reason, is vastly more costly to the railroads than it was a few years ago.

Obviously, few railroads would think of asking their maintenance employees to give up smoking on the job; this form of idleness is cited merely to illustrate a point. But there are many other causes of lost time, much more costly than the one mentioned, that *are* subject to control and which should be scrutinized carefully with a view to eliminating or reducing them.

One of these is the time lost by entire gangs in making closures for trains when work is done under traffic. Such losses cannot be eliminated altogether, especially on single-track lines, but the experiences of a number of roads with the so-called "detour" system of doing out-of-face maintenance jobs on multiple-track lines has shown that it offers large possibilities in this respect. Frequently, this and other ways of obtaining full use of a track during working hours have failed of adoption in the past because of opposition from the transportation department. Where such has been the case maintenance officers will be guilty of a serious mistake if they do not renew or continue their efforts to obtain greater use of the tracks, bearing in mind that present high wage rates give them a stronger argument than ever before.

There are, of course, many other opportunities for saving production time, which should not be overlooked. One is closer attention to the organization of individual gangs to bring the various operations into better balance with each other. Another is the more intensive use of power equipment and tools. A third is greater attention to the proper upkeep of this work equipment to prevent breakdowns in the field.

For every five-cent loss incurred when a trackman lights his pipe, there are hundreds of dollars wasted when production time is lost due to other reasons. These are enemies of efficiency that should be searched out relentlessly and eliminated wherever possible.

Is Greater Efficiency Possible?

It's Up to You!

By S. R. HURSH

Assistant Chief Engineer—Maintenance
Pennsylvania
Philadelphia, Pa.

S. R. Hursh

Based on an address presented before the Roadmasters' convention at Chicago in September, this article is a frank and searching analysis of the situation facing the maintainance-of-way supervisor today. After emphasizing the need for greater efficiency in maintenance work, and the reasons for it, Mr. Hursh exhorts each supervisor to take a personal inventory of himself and his attitude toward his work. He then proceeds, by posing many penetrating questions, to outline a method of procedure designed to uncover and correct weaknesses in maintenance methods and the track structure.

DO YOU KNOW that in the past 20 years the ever-increasing demand for labor, not only on the railroads, but in all industry as well as on the farm, has caused the hourly rate of maintenance-of-way labor to double, and that the increased cost of labor in industry generally has caused the materials we use on the railroads to go up 75 per cent in cost? During the same 20 years freight revenues increased only 6.7 per cent (July, 1947, compared with July, 1927), while passenger revenues decreased 22.6 per cent. In marked contrast, taxes have continuously increased. In 1927 the federal income tax was at the rate of 13.5 per cent, while in 1947 the rate is 38 per cent.

During 1946, the first post-war year, the average maintenance-of-way ratio of all Class I railroads operating over 2,000 mi. of lines was 14.88 per cent, and for the first six months of 1947 it was 13.57 per cent.

When it is considered that certain fixed charges of most railroads have increased, including taxes and depreciation—the latter due to extensive improvements made in the past 20 years to keep the plant modern—it becomes apparent that it is not possible to increase the per cent of gross revenue available for maintenance. As a result, the actual dollars available for maintenance of way work are less today than 20 years ago. Twenty years ago we did not have payroll taxes, which today are 8¼ per cent, and will go higher.

Many Exacting Problems

There are many problems confronting our maintenance organizations, problems more complex and exacting than 20 years ago, or even 10 years ago. Today both freight and passenger trains are longer. They are heavier and faster. These conditions require a much stronger and better track structure than our predecessors had to provide for equipment then in use.

The traveling public demands a smoother, safer, cleaner ride. Better terminal and station facilities are required in order to serve our patrons in a proper and speedier manner. The public is demanding improved road crossings and protection at such crossings, and many other improvements—all at the sole expense of the railroads—while their competitors in the transportation field are all heavily subsidized by the taxpayers.

With this situation confronting us, it is necessary for the maintenance-of-way department of every railroad to do its job better than ever before and at no increase in

Do We Take the Time Occasionally to Study Specific Operations with a View to Determining if Cost Savings Can Be Made?

total cost per million gross ton-miles. To many this looks like a hopeless task—but if each of us will study the problem on our own railroad we will find it is not. The job must be done, and it is being done. It is the men on the "firing line"—the ones who are spending the money and supervising the work—who have been doing it. The problems ahead of us call for more study, more research, more intense thought to save more dollars by finding more efficient ways of doing our work.

"How can the job be done? There is no one answer. Increased efficiency and economy provide a general answer, but specific answers must be given to be helpful. The old definition of efficiency—'laziness brought to a fine point'—will not do in this instance. Today maintenance of way management and supervision must be more alert, more critical in a constructive manner, more dollar conscious—yes, even penny conscious."

How can the job be done? There is no one answer. Increased efficiency and economy provide a general answer, but specific answers must be given to be helpful. The old definition of efficiency—"laziness brought to a fine point"—will not do in this instance. Today maintenance-of-way management and supervision must be more alert, more critical in a constructive manner, more dollar-conscious — yes even penny-conscious.

Personal Inventory Indicated

It might be well for each of us to take a personal inventory as to what manner and type of roadmaster, division engineer, or supervisor he may be. Are you an individual through whom orders are transmitted from the men above you to the men who work for you, or are you the directing head of your division or territory? How many times during the day or how many days of the week do you question yourself as to just what you did on that particular day or during the week to contribute to the financial or economic welfare of your department or your company? In other words, did you ever conscientiously question yourself as to whether you earned your salary for that day by constructive thinking or planning, or were you simply carrying out orders?

There are a number of other questions we might ask ourselves. Do we take the time occasionally to go out on a specific job and, by observation and consultation with the foreman, develop whether the job may be done at less cost by the use of fewer men, possibly by having closer cooperation between our department and the transportation department whereby we could secure more use of the track, or do we leave such matters to the foreman? Do we, by the manner in which we conduct ourselves, encourage expressions of thought from our poorest foreman as well as from the best? Are our men free to come to us and to criticize the manner in which the work is performed or the kind of material and the type or kind of tools they are furnished? If, by your actions, you encourage the men under you to think and to give helpful suggestions to you, there is no question but what you are getting efficiency and economy out of your organization.

Cost Figures Necessary

Are you providing the proper tools, the proper equipment in the nature of labor-saving devices, so your foremen can perform their work in the most economical manner with the minimum number of men? Have you, as a supervisor, division engineer, or roadmaster, ever kept cost figures on the performance of routine work? As a supervisor, have you studied the performance of your respective foremen and made comparisons as to the efficiency of one foreman with respect to another; the cost of maintaining one foreman's section against that of another? Have you, as a roadmaster or a division engineer, ever done likewise for your different supervisors? Do you know what it is costing you to maintain a mile of your main track and a mile of your branch, yard, or side tracks? If you have never made this analysis to learn what it is costing you to maintain the railroad under your jurisdiction, it is suggested that this be done immediately.

Do you, as an individual, know the costs of materials that are used daily in your department? Do your foremen, or even the men in the gangs, know the cost of rail, or of individual items of other track material, or of the tools they work with? Unless you and the men in your organization are conscious of costs, it will be difficult to increase the efficiency of your particular department.

Some Penetrating Questions

Have you ever analyzed why it costs more to maintain a particular stretch of track than one at another location on the same division? When this is done the following questions must be answered:

(1) Do you know the character and type of the subgrade? If it is bad, have you ever made a survey to determine corrective measures that may be taken, leaving to your superior the responsibility of providing the necessary funds?

(2) Are you sure that you are using the proper kind and type of ballast for the amount of traffic and the speed of trains operated?

(3) Are you using the proper size of ties and the correct number per rail for the traffic carried?

(4) Are you using the proper size of tie plates?

(5) Are you using the proper weight of rail?

(6) Are you using the right kind of splices? Are they four-hole or six-hole?

(7) Are you working the track in such a manner as to achieve complete rehabilitation on the proper time cycle?

Regarding the first question raised —troubles with the subgrade—I think we can all agree, whether the trouble is on a fill or in a cut, that it can be traced to poor construction when the railroad was originally built or to poor maintenance practices since. As to construction, was the area supporting the fill properly drained when the embankment was built, or is it now more or less of a swamp of insufficient stability to support the fill? Is the fill adequate in width at its base, as well as its crown, to support the track structure and the loads now being carried? Was the proper material used in making the fill?

As to the maintenance practices since construction, have we, over the years, continually raised the track without widening the roadbed and providing adequate shoulder support, or do we now have two tracks where one was originally contemplated? All of these questions can be answered easily, and when this has been done it will not be difficult to find the corrective measures to be taken.

The Matter of Ballast

With reference to the proper kind of ballast for the traffic and speed of trains operated, should we use cinders, gravel (small or large), slag, or a good grade of limestone or trap rock? It is well known that good

engine cinders make excellent ballast on good subgrade, providing we have rail of sufficient size and an adequate number of ties. If the track cannot be maintained economically in cinder ballast, is it a rail problem or an insufficient number of ties per rail, or, rail and ties being adequate, is there too much tonnage and speed? It may be necessary to go to gravel, slag, or stone ballast.

If you are using the proper rail section for the tonnage carried and a tie plate of adequate size, and the average life of the ties is low for the division, or the renewals are unduly heavy in a given territory, it is quite evident the ties are inadequate as to size and quantity used per rail panel. A study of the conditions causing the ties to fail should reveal the corrective measures to be taken.

Assuming that the correct rail section and the required size and number of ties are being used, what does a study of the tie failures disclose; how are the ties failing? Are they being spike-killed from continual gaging? Have they been adzed to a point where they are splitting and shattering under wheel loads? If these conditions obtain, in all probability larger plates, adequately secured to the ties, are needed.

Many studies have been made to determine the economical size of rail. These studies may be used as a guide for each individual road, and the information derived therefrom may be correlated to the policy of laying new rail. How many years of first life cycle is expected and what is it costing to get the first life cycle now being obtained?

Knowing the kind of ballast used, the number of ties per rail length, the tonnage and speeds of trains, and the standard of track needed for the traffic handled, the most economical size of rail can be readily determined, it being understood, of course, that the capital investment will be included in determining the annual cost. It will be found that the largest section that can be justified will in the end be the most economical.

Regarding the proper type of splice bar (whether four-hole or six-hole) to be used, there have been many studies made, the conclusions of which are available in the proceedings of the A.R.E.A. These studies will aid in determining which type is best for the traffic carried. We know that on heavy, stiff rail, the six-hole bars provide a better alinement on curved track, as such bars have a greater capacity to resist the tendency of the rails to aline in a series of chords between rail ends, a condition which is apt to obtain with the shorter four-hole bars.

"How many times during the day or how many days of the week do you question yourself as to just what you did on that particular day or during the week to contribute to the financial or economic welfare of your department or your company? In other words, did you ever conscientiously question yourself as to whether you earned your salary for that day by constructive thinking or planning, or were you simply carrying out orders?"

Other Considerations

It is also known that, where four-hole bars are used, increased wear takes place in the joint, followed by increased batter at the rail ends. In addition to requiring more frequent renewal of bars and welding of the rail ends, there is an adverse effect on the life of the rail. Studies have disclosed that rail with four-hole bars must be renewed rapidly after its sixth year and that the average life of rail with such bars is 10.7 years as compared to 14.5 years for rail with six-hole bars and with the same traffic. When it is considered that nearly 25 per cent of total maintenance money is spent on track laying and surfacing and that 75-80 per cent of this amount is spent on surfacing and lining joints, it becomes apparent that care should be used in determining the kind of joint to be used. Not only should splice bars be of the proper size but they should also be of such cross-sectional area as to permit of at least two reforming processes, making possible the building up of an adequate pool of reformed bars to be used when welding is necessary.

Assuming that the subgrade and drainage are good and that the correct size and type of ballast, the proper size and number of ties per panel, and the correct size of tie plates, rail and splice bars, are being used, the proper time cycle for working the track is next in importance. In all probability this factor is the most important so far as reduced track maintenance costs are concerned, when one considers the general deterioration that occurs in all parts of the track structure when the track is not worked at the proper time. In fact, the riding condition of the track may not be the determining factor in deciding what should be done or when it should be done. The track may ride good enough for the type and kind of traffic handled and the authorized speeds of trains.

"Do you, as an individual, know the costs of materials that are used daily in your department? Do your foremen, or even the men in the gangs, know the cost of rail, or of individual items of other track material, or of the tools used? Unless you and the men in your organization can become conscious of costs, it will be difficult to increase the efficiency of your department."

In this connection there are a number of questions to be answered. For instance, how much labor is spent on lining and surfacing to keep the track in the condition that now obtains? How is the gage, and is it necessary to regage the entire stretch? If so, the track is in all probability centerbound, indicating that very shortly the rail will be ruined, not only at the joints, but it will be flange worn in the quarters, a condition that may obtain on tangent track as well as curves.

I am not unmindful of what has been passing through the minds of some with reference to the thoughts expressed above. Specifically, there may be doubts as to whether the problems here mentioned are those of the supervisors, roadmasters, and division engineers, or of their superiors. The need for increased efficiency and economy on the railroads is so urgent that management must have the help of each department, and since these officers are the management, so far as the maintenance of-way department is concerned, it is their problem. It is my sincere hope that we may all resolve that the problem is ours as individuals and that we will study our own subdivisions and divisions to the end that each may contribute his due share towards increased efficiency and economy.

Rail Output Drops 18.7 Per Cent in 1946

A SHARP reduction in the output of rails in 1946, bringing production down to a level comparable with that of 1941, is shown by figures published in the latest annual statistical report of the American Iron and Steel Institute. This report shows that a total of 1,965,642 net tons of rails was produced in 1946, a drop of 451,878 tons, or 18.7 per cent, compared with 1945. Widespread strikes in industry and enforced retrenchment of the railroads are considered to be the chief causes for the sharp decline, which brought production for the year to the lowest level since 1941.

In the accompanying table, showing the production of rails from 1927 to 1946, inclusive, the output for each year is broken down into four weight groups. In this table it will be noted that all groups in 1946 fell off from the previous year. However, the two heaviest groups continued to hold their own in production, accounting for 80 per cent of the total output for 1946 as compared with 79.2 per cent in 1945. An interesting fact revealed by the table is that the tonnage of rails in the group weighing 120 lb. and over was the largest of any of the four groups for the first time, except in 1933, registering 40.4 per cent of the total production, as compared with 38.5 per cent in 1945. At the same time, the group weighing 100 lb. and less than 120 lb. decreased from 40.7 per cent of the total production in 1945 to 39.6 per cent in 1946.

While the production of rails in all groups was decidedly lower in 1946, the least decline occurred in the heaviest group. Specifically, the production of rails weighing 120 lb. and over decreased from 930,987 tons in 1945 to 794,775 tons in 1946, a loss of 14.6 per cent as compared with 18.7 per cent for all groups. In comparison, the production of rails weighing 100 lb. and less than 120 lb. dropped 21 per cent; the group weighing more than 60 lb. and less than 100 lb. showed a decrease of 23.1 per cent; and that weighing 60 lb. or less dropped 18.5 per cent.

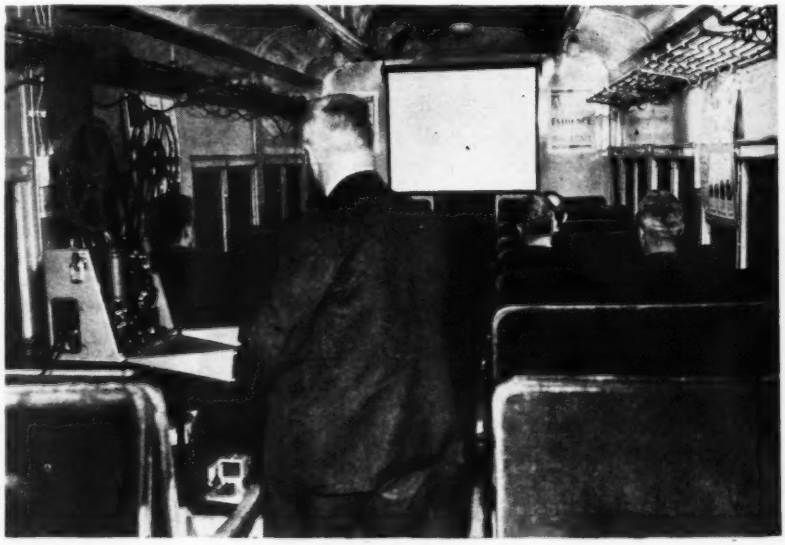
Of the total tonnage of rails produced in 1946, 1,900,252 tons, or 96.6 per cent, were rolled from open-hearth steel, a decrease as compared with the 97.2 per cent registered in 1945. No rails were rolled from Bessemer and electric steels in 1946, as compared with 5,835 tons in 1945. The tonnage of open-hearth rollings from new seconds increased from 6,505 tons in 1945 to 13,518 tons in 1946. Also included in the total output for 1946 were 51,972 tons rolled from old rails and 21,114 tons of girder and high tee-rails.

The output of fastenings in 1946 showed approximately the same sharp reduction as of rails, dropping from 784,843 tons in 1945 to 643,337 tons in 1946, a decrease of 18 per cent. The total output of fastenings in 1946 included 151,149 tons of joint or splice bars, 42,043 tons of other rail joints and 450,145 tons of tie plates.

Production of Rails by Weight per Yard—Net Tons

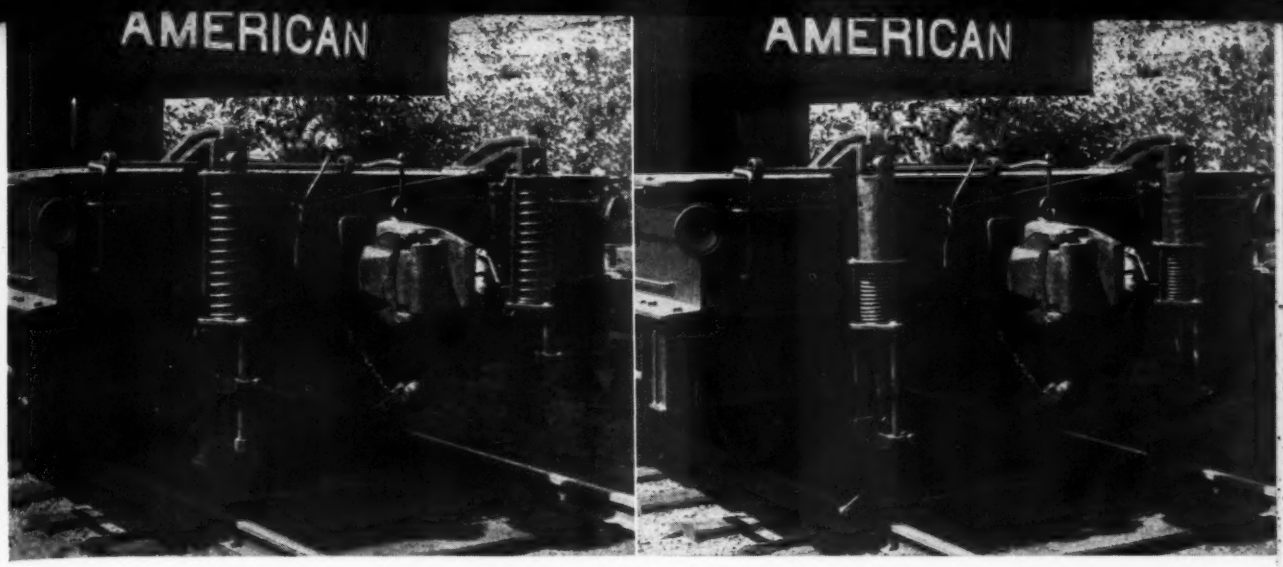
Years	60 lb. or less	Over 60 and less than 100 lb.	100 and less than 120 lb.	120 lb. and over	Total
1927	181,256*	798,226†	1,472,155	691,627	3,143,264
1928	150,301*	662,053†	1,348,199	804,639	2,965,192
1929	158,326*	574,080†	1,381,631	934,758	3,048,795
1930	107,101*	391,079†	935,756	664,085	2,098,021
1931	56,100*	166,793†	555,242	518,546	1,296,681
1932	18,654*	47,374†	240,902	143,944	450,874
1933	55,010	63,153	172,488	175,601	466,252
1934	78,495	101,640	550,639	400,677	1,131,451
1935	63,982	112,431	381,696	238,812	796,921
1936	107,644	135,585	684,910	438,089	1,366,228
1937	113,889	218,374	815,280	471,685	1,619,228
1938	50,375	85,177	371,534	190,556	697,642
1939	92,994	83,611	620,992	515,050	1,312,647
1940	140,443	339,672	688,109	510,762	1,678,986
1941	172,264	323,968	820,695	610,924	1,927,851
1942	124,938	438,562	924,851	607,808	2,096,159
1943	164,096	364,715	847,839	750,346	2,126,996
1944	162,942	401,213	1,032,256	894,245	2,490,656
1945	150,724	350,499	985,310	930,987	2,417,520
1946	122,739	269,720	778,408	794,775	1,965,642

* Under 50 lb. per yd. † 50 and less than 100 lb. per yd.



Safety Instruction Car

SHOWN above is an interior view of the Canadian National's safety instruction car, which is visiting many points on every division of this road in an extensive "No Accidents" campaign. The car is equipped to show 16-mm. sound motion pictures to as many as 50 employees at one time. Two types of films, both dealing with matters of safety, are shown. One type is of a general nature and is intended for the instruction of employees from all departments, while the other is shown to those whose duties are more hazardous, such as road and yard trainmen, car repairmen, section laborers and motive power employees. Last year 14,860 Canadian National employees saw and discussed safety instruction motion pictures as part of the road's accident-prevention program.



Two Views of a Locomotive Crane Equipped with the Automatic Rail Clamps, Showing the Clamps in the Raised and Lowered Positions

Automatic Rail Clamps for Locomotive Cranes

A total of 19 locomotive cranes on the N.Y.N.H. & H. are now equipped with automatic cab-controlled rail clamps. Use of these clamps is not only promoting greater efficiency in the operation of cranes but is also enhancing the safety factor when handling heavy loads. This article describes the clamps and tells how they are operated.

THE New York, New Haven & Hartford has developed an automatic, cab-controlled rail clamp for application to locomotive cranes, and has equipped 19 of its cranes with the clamp. Merely by throwing a lever in the cab these clamps can be applied or released by the crane operator in a few seconds, and are a time-saving as well as a safety device because the clamps used formerly had to be applied and released by hand, requiring several minutes for each operation.

Cranes equipped with the automatic rail clamps have four such clamps, two at each end. The clamps are operated by individual air cylinders with spring returns, and the air supply to, and its release from, all four cylinders is controlled simultaneously by a solenoid valve actuated by a cab switch. The clamp switch is interlocked with the travel brakes on the crane, so that the clamps cannot be applied except when the brakes are set, and the brakes cannot be released until the rail clamps have been disengaged.

Principal Parts

By means of a steel bracket fastened to the top side of the crane deck, each rail clamp assembly is suspended over the rail at a point 6¾ in. from the end of the deck. Principal elements of each assembly include an air cylinder with piston and rod; a return spring surrounding the cylinder, with sliding retainer bolts, the lower ends of which are attached to the end of the piston rod by a yoke; and the rail-clamp assembly which is suspended from the cylinder by hanger rods in such a manner that the clamp is actuated by the up-and-down movements of the piston rod.

In the absence of air in the cylinder the return spring keeps the piston, and hence the rail clamp, in the raised position. When air is admitted to the cylinder the piston is forced downward, compressing the spring and at the same time, through the movement of the piston rod and attached assembly, causing the rail clamp to grip the head of the rail. To release the clamp, air is exhausted from the cylinder, thereby permitting the spring to return the piston to the upper position, a movement that causes the rail clamp to be released and raised into the clear.

How Controlled

An ingenious system of controls was devised for the automatic rail clamps to interlock them with the travel brakes of the crane in such a manner as to forestall application of the clamps until the brakes have been set or to keep the brakes from being released until the clamps are in the raised position. This is done by a system of electrical controls, using solenoid valves to control the air to the brakes and rail-clamp cylinders. On gasoline-engine-driven cranes this system uses the 12-volt storage battery circuit with which these cranes are equipped, while on steam cranes use is made of the 32-volt steam-generator systems which have been installed on these cranes to provide power for the lights used in night operations.

Provided in connection with the travel brake lever is a locking pin, a hole for receiving it, and a latch spring. When the rail-clamp switch is turned on, and with the brake lever in the "full-brake" position, the latching solenoid is energized, causing the locking pin to be pulled into the hole in the lever. When it reaches the end of its movement the locking pin closes another circuit, thereby operating three solenoid valves, one admitting air to the rail-lamp cylinders and the other closing the normally-open quick-release valves on the clamp cylinders at each end of the crane. The result is that the rail clamps are applied.

Limit Switches Used

When the clamp switch is turned to the "off" position the solenoid valve admitting air to the cylinders is closed and the two quick-release valves are opened, releasing the air. The resulting movement of the clamps to the raised position causes a limit-switch on each of them to be opened. These

four switches are connected in parallel through an auxiliary circuit controlling the locking pin on the brake lever and the latter is not released until all of the rail clamps are in the raised position.

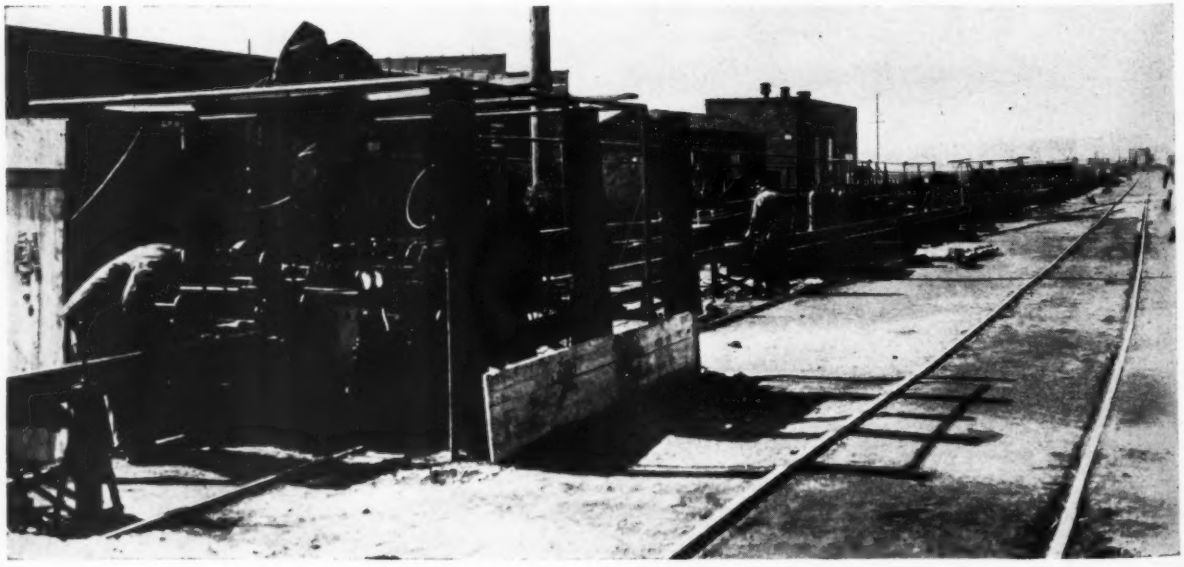
The original safety rail clamps were designed and constructed in the work equipment repair shop of the New Haven at New Haven, Conn., under the direct supervision of F. F. Zavatkay, at the time supervisor of welding and equipment, and now special assistant to engineer, maintenance of way. Other than these original clamps, those applied to date were manufactured by the McKiernan-Terry Corporation, New York.

Produces "Tailor-Made" Lengths from Used Rail

RECENTLY, the Atchison, Topeka & Santa Fe produced a considerable quantity of rail in "tailor-made" lengths from used rails by first cropping them, then pressure-welding the shortened pieces into a continuous length and finally cutting the long string into the desired lengths. The purpose was to obtain long rails in multiples of 39 ft. for use through road crossings in passing tracks in C.T.C. territory.

The various operations involved in carrying out the cutting and welding work were performed at a temporary set-up at Newton, Kan., using the Oxweld oxy-acetylene pressure-welding method for joining the rails. The used rail employed was all of the 110-lb. section, but in the same operation a quantity of new 112-lb. and 131-lb. rail was also transformed into tailor-made lengths in the same manner.

The ends of the 110-lb. rails were worn and battered, and the first step in converting them into the tailor-made lengths was to crop 18 in. from the ends of each rail. In cropping the rails, which was done with a Racine portable gasoline-driven rail saw, the work was facilitated by lapping two rail lengths the necessary distance and cutting them simultaneously. The 36-ft. rail lengths were then pressure-welded together, a total of 117 such rails being welded into a single string having a total length of about 4,210 ft. Following the completion of the welding and finishing operations, the long rail was sawed into lengths of 78 ft., 117 ft. and 156 ft., this cutting work also being done by a gasoline-driven rail saw. Since the welds were located every 36 ft. it is apparent that the ends of the rails, as cut apart to produce the specified lengths, came at locations other than the welds.



Right—Showing How the Ends of Two Rails Were Cropped Simultaneously with the Racine Saw by Lapping the Ends. Below—The Welding Set-Up at Newton by Which Used 110-Lb. Rail, With 18 In. Cropped from the Ends, Was Welded Into a String 4,210 Ft. Long

Chicago Meeting Shows B. & B. Group Is a Potent Force

Bridge and Building Section

Success of fifty-second annual convention, characterized by unusually large attendance and a constructive program, emphasizes the increasing importance of this association in providing adequate railroad structures

EVIDENCE that the American Railway Bridge and Building Association is a force of increasing potency in furthering the railroads' efforts to assure adequate, modern structures, economically maintained, to serve their various needs, was present in abundance at Chicago on September 16-18. At that time the association held its fifty-second annual convention, a meeting that possessed all the elements necessary to an outstanding affair. The more important of these ingredients included a highly constructive program of committee reports and addresses, and an excellent attendance, with the "frosting on the cake" being provided in the form of a high degree of interest manifested in the proceedings by all of those present.

Doubtless contributing to a considerable extent to the success of the meeting was the fact that, continuing a precedent established last year, it was held concurrently under the same roof (the Stevens hotel) with the annual convention of the Roadmasters' and Maintenance of Way Association, the activities of which were reported in the October issue. Experience with this arrangement during the two years it has prevailed revealed a number of advantages, including the fact that members of one group have the opportunity of participating in any programs of the other that may be of particular interest to them. While the meetings of the two groups were for the most part held entirely separate from each other, the groups were brought together on two occasions, including the opening session, to participate in programs of mutual interest.

Attendance Above Last Year

Not the least encouraging feature of the meetings was the fact that during the three-day period they were in session a total of 765 members and guests registered their attendance. This figure is considerably larger than the registration of 693 last year—a registration which, incidentally, was considered excellent at the time.

Affording an interesting sidelight on the meetings, and serving also as a further indication of the widespread interest attracted by them, was the fact that nine technical committees of the American Railway Engineering Association scheduled meetings to be held in Chicago while the conventions were in session, thus enabling the members of these committees to participate in any programs of interest to them.

Not to be overlooked in any account of the activities of the week is the large joint exhibit of manufacturers' products that was presented in the exhibit hall of the hotel jointly by the Track Supply Association and the Bridge and Building Supply Men's Association.* With a total of 96

*A complete list of the companies exhibiting, together with the names of their representatives present and mention of the products displayed, was published in the October issue.

F. G. Campbell
President
Bridge and Building Association

companies participating this exhibit was even larger than the record display that was staged last year by 90 firms.

The combined opening session of the conventions was presided over jointly by F. G. Campbell, chief engineer, Elgin, Joliet & Eastern, and president of the Bridge and Building Association, and by E. J. Brown, engineer of track, Burlington Lines, and president of the Roadmasters' group. Mr. Campbell and Mr. Brown also functioned jointly in directing the activities of another joint session held on Wednesday afternoon. All separate sessions of the Bridge and Building group were presided over by Mr. Campbell, assisted by J. S. Hancock, bridge engineer, Detroit, Toledo & Ironton (first vice-president), and E. H. Barnhart, division engineer, Baltimore & Ohio (second vice-president).

J. S. Hancock
First Vice-President

E. H. Barnhart
Second Vice-President

W. F. Martens
Third Vice-President

W. A. Huckstep
Fourth Vice-President

C. R. Knowles
Treasurer

Greetings from Other Groups

The opening session, as reported in the October issue, was devoted in part to words of greeting from the American Railway Engineering Association by Armstrong Chinn, president, Terminal Railroad Association of St. Louis, and president of the A.R.E.A.; from the Track Supply Association by H. M. McFarlane, president of that asssociation; from the Bridge and Building Supply Men's Association by W. L. McDaniel, president of that group; and from Lewis Thomas, secretary of the Track Supply Association and director of exhibits for both supply groups.

The final feature on the program of the joint opening session was an address by J. H. Aydelott, vice-president, Operations and Maintenance department, Association of American Railroads. At a subsequent joint session the two groups were addressed by Ralph Budd, president, Burlington Lines, who spoke on Problems of Railway Management and How Our Groups Can Help. The program of this same joint session also included two motion pictures. One of these, entitled Suggestions Unlimited, dealt with the Illinois Central's employee suggestion system, and was presented through the courtesy of that road. The other, entitled Maintenance of Way Mishaps, was shown through the courtesy of the Southern Pacific. Abstracts of the addresses by Mr. Aydelott and Mr. Budd were included in the story of the Roadmasters' convention in the October issue.

President Campbell Comments

After calling the separate session of the Bridge and Building Association to order, President Campbell reviewed the history of the association, pointing out that it is nearly half as old as the railroad industry itself. Noting that the members, in discharging their responsibilities, are having to cope with shortages of materials and labor, at a time when costs of both are going up, he said that it is the responsibility and duty of the members to seek solutions to the problems thus presented. This can only be done, he said, by more efficient operation, based largely on the further development of labor-saving machines. Reporting on the year's activities of the association, President Campbell said that, in at least one respect—the procurement of new members—it was one of the best years ever experienced by the organization. An active membership campaign, he said, resulted in the recruiting of 97 new active members and 13 new associate members. As a result, he said, the association now has a total of 568 dues-paying members.

Ensuing separate sessions of the Bridge and Building Association were given over in large part to the presentation and consideration of eight technical committee reports and two addresses, which together dealt with a broad cross-section of the problems facing the men in this group. The committee reports covered the following subjects: Economies To Be Derived Through the Modernization of Obsolete Water Stations; Construction and Maintenance of Shops and Enginehouse Floors and Runways; Development and Training of Supervisory Personnel in Bridge and Building and Water Service Forces; Glued, Laminated Members in Bridges; Unfilled Needs in Power Machines and Power Tools for Bridge and Building Work; Safety Measures to Protect Employees Within Buildings Against Fire and Accidents; Utilization of New Types of Material in Buildings; and Inspection of Substructures and Underwater Foundations.

Of the two addresses that were

Bridge and Building Association

Officers 1946-47

F. G. Campbell, president, asst. ch. engr., E.J.& E., Joliet, Ill.

J. S. Hancock, first vice-president, br. engr., D.T.& I., Dearborn, Mich.

E. H. Barnhart, second vice-president, div. engr., B.& O., Garrett, Ind.

W. F. Martens, third vice-president, gen. fore. b.& b.& w.s., A.T.& S.F., San Bernardino, Cal.

W. A. Huckstep, fourth vice-president, gen. bldg. supv., M.P., St. Louis, Mo.

Elise LaChance, secretary, Chicago.

C. R. Knowles, treasurer, supt. w. s., I.C. (retired), Chicago.

Directors

Guy E. Martin, supt. w. s., I.C., Chicago.

B. R. Meyers, asst. to ch. engr., C.& N.W., Chicago.

L. E. Peyser, prin. asst. arch., S.P., San Francisco, Cal.

F. R. Spofford, asst. div. engr., B& M., Dover, N.H.

H. M. Harlow, asst. gen. supv. b.& b., C.& O., Richmond, Va.

H. B. Christianson, prin. asst. engr., C.M.St.P.& P., Chicago.

presented, one was delivered by E. J. Ruble, structural engineer, research staff, Association of American Railroads, on Recent Tests on Determination of Impact and Stresses in Steel, Masonry and Timber Bridges. The other address, entitled The Power of Color, was presented by George D. Gaw, director, Color Research Institute of America. Abstracts of both these addresses are presented later in this article.

Special Events Add Interest

Interest was added to the meeting by a number of special events. One of these was the presentation of an honorary membership certificate to Charles H. Buford, executive vice-president, Chicago, Milwaukee, St. Paul & Pacific, who was elected to this capacity at last year's meeting. Also, action taken at the meeting this year resulted in the election of one new honorary member, namely, Clarence R. Knowles, superintendent of water service (retired), Illinois Central, who has been active in the work of the association for many years, having served as president in 1921-22.

Other special events included the annual banquet held on Wednesday night, which was a joint affair with the Roadmasters and was attended by a total of 984 persons; and an inspection trip on Thursday afternoon, also joint with the Roadmasters, to the Carnegie-Illinois steel plant of the United States Steel Corporation at Gary, Ind.

New Officers Elected

In the election of officers to serve during the coming year, Mr. Hancock was advanced from first vice-president to president; Mr. Barnhart was advanced from second vice-president to first vice-president; W. F. Martens, general foreman, bridges, buildings and water service, Atchison, Topeka & Santa Fe, San Bernardino, Cal., was advanced from third vice-president to second vice-president; W. A. Huckstep, general building supervisor, Missouri Pacific, St. Louis, Mo., was promoted from fourth vice-president to third vice-president; Guy E. Martens, superintendent water service, Illinois Central, Chicago, was elected fourth vice-president; and Mr. Knowles and Elise LaChance were re-elected treasurer and secretary, respectively. The new directors elected were: Lee Mayfield, resident engineer, Missouri Pacific, Houston, Tex.; Franz M. Misch, general bridge and building supervisor, Southern Pacific, San Francisco, Cal.; and W. D. Gibson, assistant engineer, Burlington Lines, Chicago.

Eight subjects were chosen for investigation by committees during the ensuing year, as follows: Protection to Bridges Over Navigable Streams; Types of Bridges for Replacing Timber Trestles; Enlarging and Relining Tunnels for Present-Day Traffic; Recent Developments in Storage and Servicing Facilities for Diesel and Oil-Burning Locomotives; Sanitary Facilities and Appurtenances for Railway Buildings; Eliminating Waste of Water; Good Housekeeping to Promote Safety and Fire Protection; and Housing Bridge and Building Employees.

Because of widespread satisfaction with the plan of holding this convention concurrently with that of the Roadmasters' Association, the decision has been made to continue the arrangement next year. The tentative date for the 1948 meeting is September 21-23.

Research on Impact

A comprehensive review of the research work that has been done in recent years, some of which is still in progress, to determine impact stresses in railroad bridges of all types was contained in the address by Mr. Ruble on Recent Tests on Determination of Impact and Stresses in Steel, Masonry and Timber Bridges. Mr. Ruble first discussed the nature of the total impact effect, pointing out that it results from several individual effects, including the roll effect, the speed effect, the track effect and the hammer-blow effect. The cause and meaning of each of these effects were discussed.

Pointing out that "the effect of a locomotive crossing a railroad bridge at various speeds has been of great interest to the bridge designer for many years," Mr. Ruble went on to review the various tests to determine the nature of this effect that have been conducted over the years, beginning in 1849 and culminating in 1935 with the development of the A.R.E.A. impact formula, which is still in use. The development of this formula, said Mr. Ruble, brought forth the need for more research on the subject, and a program of tests was undertaken by a special committee on impact, which now exists as the standing Committee on Impact and Bridge Stresses of the A.R.E.A.

Explaining that the electro-magnetic type of measuring equipment, with oscillograph recordings, was selected as the type of strain gage that would be most suitable for the work, Mr. Ruble traced the development of this type of gage and explained how it is used. Next he described the tests that were conducted on seven short-span bridges from 1941 to 1943, noting that the general procedure was to secure records under both Diesel and steam locomotives at various speeds with a battered rail joint in one rail close to the center of the bridge. He then reviewed the results of these tests, which showed, among other things, that the total impact effect is somewhat less than that allowed by the present A.R.E.A. specification.

Mr. Ruble then turned to a discussion of tests that were made in 1946 on five girder spans varying from 40 ft. to 70 ft. in length, pointing out that these tests are being continued. He then described a number of tests that have been carried out at the request of individual railroads on some of the older truss spans in service today to determine if they are capable of carrying present-day loads. After discussing the results of these tests, Mr. Ruble described some tests that were made in 1941 on a truss span 102 ft. 6 in. long, in which vibrations were induced by means of a mechanical oscillator.

Other subjects discussed in this address included reference to a test to determine the strains in a large concrete pier, plans for making tests on several concrete pile trestles, the results of tests to determine the loads on individual ties in open-deck girder spans, the effect of fatigue on the floor-beam hangers of through-truss spans, the results of tests to determine the fatigue strength of welded structural joints, and a test that is being made to determine the concrete bearing pressures under a railroad bridge rocker slab.

Power of Color

The address by Mr. Gaw on the Power of Color revealed some surprising attributes of color, including its psychological effect on human beings. The psychological power of color, said Mr. Gaw, is predicated on its exact hue. In other words the effect from a cold red (red and blue) is very different from that of a warm red (red and yellow), while a green blue will not affect us the same as will a purple blue.

Red is the most stimulating of

B. & B. SECTION

colors, said Mr. Gaw, while yellow produces the sensation of sunlight, and blue is the coldest of the colors. To indicate what he meant by these properties Mr. Gaw went on to describe case histories demonstrating the power of color over the physical and emotional well-being of human beings.

Yellow has the best visibility of all colors and plays an important part in accident prevention, he said. Explaining that yellow and black comprise the most effective combination for visibility, Mr. Gaw said that this combination is best where quick attention is essential and where reading at a distance is a factor. However it should never be employed where legibility is needed because it is cutting to the eyes and will not hold sustained attention, he asserted.

Color planning for modern industry embraces, in addition to the psychological factors, the symbolic values and the visibility aspects of colors. In other words, said Mr. Gaw, we associate red with danger, green with nature and safety, etc., and these associations have become part of the subconscious mind. Confusing visibility with legibility is one of the common errors made in color usage today, he said.

Explaining the uses of color in industry, Mr. Gaw said that there are some general color principles that can be applied to all working places. Except in special cases, he said, plant ceilings are painted white because this is the color that reflects maximum light. White is not used on walls, he said, because workers should be surrounded by colors that should make them feel at ease and do not cause eye fatigue. The color on the walls must be in keeping, he asserted, with those on the machines and should be in harmony with the function of the establishment.

In a plant that has a scientifically-designed color scheme, said Mr. Gaw, everything in the place—walls, ceilings and machines—are treated with colors that aid production. Such a design, he said, results in more accurate and faster work, happier and less-tired employees, a lower accident rate, and better relations with employees.

Economies To Be Derived Through The Modernization Of Obsolete Water Stations

Report of Committee

H. E. Graham
Chairman

THE conditions relative to water supply on the railroads have changed more drastically in recent years than most other phases of railway operation. The increase in the size of locomotives, higher boiler pressures, and larger locomotive tenders and auxiliary tenders have combined to bring about many changes and advancements in every phase of water supply. Rapid increases in the use of Diesel locomotives are introducing new conditions of water supply. And the supply of drinking water to trains, stations and shops must also meet the new standards adopted by the U. S. Public Health Service.

Many Advances

In the early days of railroading water requirements were limited and supplies were usually secured from streams, ponds or shallow wells without much consideration to the quality of the water. The pumping was often done manually or by horse power. As the railways continued to expand, more and better water supplies were required and more mechanical equipment was developed and used for pumping. In the evolution, the windmill, the stream and internal combustion engines of various types and models have been used, but these are being discarded progressively for more modern types of equipment. During the last 23 years electric-driven pumping units have continued to improve until this form of power is generally considered to be the most economical and efficient for water facilities, although at some locations there may be factors which require the continued use of steam or internal combustion engines. The selection of pumping equipment should include a careful analysis of costs and dependability.

The progressive changes that have occurred in the past may be expected to continue in the future in meeting the water requirements of modern railroads—requirements which amount to billions of gallons of water annually for locomotives, buildings, shops and other facilities. This water should be adequate in volume and should be treated where necessary to prevent scale, corrosion and foaming in boilers.

In connection with the urgent demands of wartime conditions during the last five years, the railroads made pronounced improvements in their water facilities. Tanks, pumping equipment, treating plants and pipe lines have been renewed or reconditioned to supply more water of generally better quality. This program should be continued where necessary and permissible. In addition to actual reconditioning work, the relocation and possible elimination of some existing water stations should be considered, as the increased use of Diesel locomotives will also affect the number and spacing of future stops for water.

Source of Supply

The source of supply is an important part of every water station. Some of the older intakes and suction lines which remain may require considerable reconditioning work. This work should be planned carefully and modern intake pumps, with necessary screens and silt-removing equipment should be used to replace obsolete facilities. The latter often consisted of timber cribs or open pipe lines laid into the water without protection from floating ice or debris. Many streams have become polluted with industrial and other waste material, with the result that these sources of supply have thereby become less satisfactory. In cases of stream pollution, a railroad may sometimes continue to use the stream until operating conditions become almost intolerable, before another source is planned. However, under such conditions, municipal supplies should be considered if the water is suitable in quality and quantity and the cost is reasonable.

In like manner the use of a well supply should be investigated. In many places, the water from deep wells has been found to be of better quality than that from surface supplies or shallow wells, and can be treated at lower cost. In fact, in some cases treatment can be eliminated entirely. Well water, as a rule, is colorless, without suspended matter, and is not subject to many of the troubles found in stream supplies. A case

is known where a railroad was forced to abandon an unsatisfactory stream supply, and in securing a good city well supply it reduced attendance, maintenance and operating expenses. This also permitted the retirement of a steam pumping plant which was obsolete and deteriorated, and generally undependable in operation.

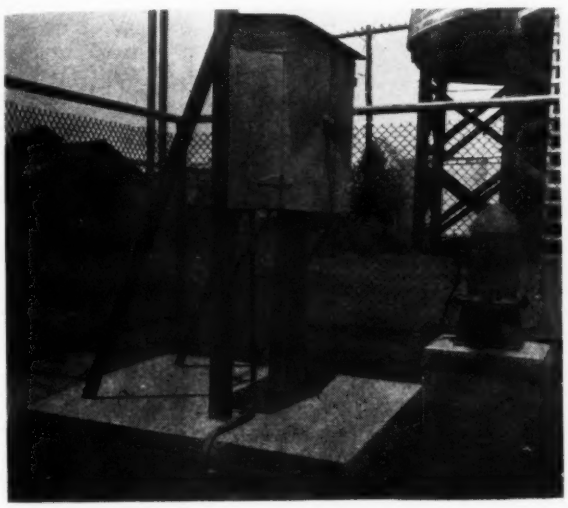
This same railroad has had very satisfactory results in several instances in the installation of wells to replace stream supplies. In these cases the well water has been superior in quality to the stream supplies that were abandoned, and by using automatically-controlled electric pumps on the wells a decided reduction was made in the operating expenses of the stations. The U. S. Department of the Interior has made extensive studies of the underground water supplies in many localities and their findings are often useful in determining the possibilities of obtaining suitable wells.

Reservoir sources of supply usually give less intake trouble than stream supplies. Where reservoirs are used, the dams should be kept clear of growing timber, spillways should be well maintained, and silting and vegetation should be removed to a reasonable extent. Such maintenance will prolong the maximum capacity of a reservoir and is desirable as a modernization program.

Power Units

Where municipal supplies cannot be used to advantage, the railroad must develop its own plants. Where this is done the selection of the power unit should receive careful consideration. While many primitive types of power were used in the earlier days, they have in most cases been replaced with either the steam engine, internal combustion engine, or the electric motor. The steam engine started to give way to the oil engine about 30 years ago and now both steam and oil units are being superseded by the electric motor.

There are many steam and oil-operated plants still in service that can be adapted for electric pumping, with the resultant economy which this method affords. New installations should be of automatic-electric equipment wherever possible. The steam plants still in existence have relatively high attendance, maintenance and operating costs. Coal is often unloaded from the main track or siding, requiring the use of section men. The equipment does not lend itself to automatic control and one or more pumpers are required for operation. The plant equipment requires relatively large housing, which, under present shortages of building materials and high labor costs, makes construction and maintenance slow and expensive. While the cost of coal still compares favorably with that of electric power for similar amounts of work, the incidental operating and maintenance costs of the steam plant are usually much higher than for complete electric operation.



"For Deep-Well or Surface Supplies, the Motor-Driven Centrifugal Pump Makes a Compact Pumping Unit and Is Readily Adaptable to Automatic Controls"

The internal combustion engines used in water pumping stations are, for the most part, of the so-called semi-Diesel type. Objections to these are somewhat similar to those found with the steam engine, namely, high installation, maintenance and operating costs. Automatic control has been used to some extent with modern internal combustion engines, but is not comparable to that found in the electric motor.

The former objections to the use of electric power units have now practically disappeared. Dependable power at reasonable cost exists in nearly all regions and installation, operating and maintenance costs are lower. Therefore, wherever economies can be effected, the railroads should adopt the use of electric pumps for new stations and also to replace existing steam and oil engine units.

For deep-well or surface supplies, the motor-driven centrifugal pump makes a compact pumping unit and is readily adaptable to automatic control. Furthermore, smaller buildings and pipe lines are required than for steam and oil units of similar daily capacity. The increases in cost for attendants, in many cases, make automatic operation of pumping stations very profitable. One railroad is known to have two operating divisions without a pumper and has made changes in equipment in the past five years that have resulted in a decrease in cost for pump attendants in excess of $100,000 annually. For these reasons the electrification of water facilities has become one of the principal items of water station modernization, and this practice should be continued.

Lime—Soda Ash Plants

Many lime and soda ash treating plants are becoming obsolete and can be modernized to advantage. The use of such plants on the railroads began about 1902. The early plants were known as the intermittent type, where the chemicals were added to the water in calculated amounts sufficient to treat one tank or other unit of water. The water was allowed to remain undisturbed until the reaction was completed, after which it was pumped into the roadside tank, and the cycle repeated.

The intermittent-type softener was superseded by the continuous type, in which the chemicals are applied to the incoming raw water by proportioning equipment, and the treating tank capacity is large enough to permit the pumping of the raw water, the softening of the water, and the transfer of the softened water as one continuous operation. The waiting period between the cycles of softened water is eliminated, with resultant increase in the plant capacity. But the continuous-type plant is now being superseded by the suspended-sludge type plant. This latter type greatly reduces the reaction time required to soften the water and thereby increases the plant capacity, with a relative decrease in the size of the reaction tank and the housing and ground space required.

One railroad reports a location where an intermittent plant was erected in 1904, was converted into a continuous plant in 1917, and was then rebuilt as a suspended-sludge type plant in 1946. The latest plant occupies less ground space, which is very limited at the location, and has a reaction tank of 50,000 gal. compared with 150,000 gal. in the former plants. Notwithstanding this, the softened water production is 36,000 gal. per hr. compared with 25,000 gal. and 15,000 gal., respectively, for the continuous and intermittent plants. The present plant has automatic electric control, and the water levels are maintained in roadside tanks, filter tanks and a soft water cistern by means of float valves and float switches.

Other railroads report effective and economical results from the suspended-sludge type treating plant. When intermittent or continuous plants are due for reconditioning or rebuilding, this type of plant should be considered as modern procedure.

Internal Treating Plants

One of the most effective methods of improving the quality of railroad water supplies in recent years has been the

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development and wide application of the internal, or wayside, method of treatment. This method, which is adaptable where scale conditions are not excessive and where the construction, maintenance and operating costs of lime and soda ash treating plants are not justified, has been improved during the last ten years to the extent that scaling, pitting and foaming conditions in steam boilers can be corrected or greatly reduced.

The use of commercial soda ash, combined with proprietary compounds, reduces the cost of the treatment to a reasonable basis. Improvements have been made in the proportioning equipment to apply the chemicals in definite amounts to the water to be treated, and the control chemists of the railroads check the water regularly to insure that the proper treatment is being maintained. Under these conditions, internal treatment is effecting decided economies in boiler maintenance, and its use should be considered where untreated water conditions are not satisfactory.

Water Service Mains

The water mains used by railroads are, for the most part, made of cast iron, which is a durable material, and which presents no unusual difficulties due to deterioration, except in a relatively few locations where the soil or the water will cause corrosion. However, there are many locations where incrustation, internal deposits, and the formation of air pockets may seriously affect the carrying capacity of the water mains, resulting in increased pumping costs.

Air relief valves should be used at summits, and blow-off valves in the valleys of water lines laid through rolling country. Considerable economies can be made by cleaning pipe lines where excessive friction loss is caused by incrustation, tuberculation, organic growth, or deposition of sediment.

In cleaning pipes, cases are known where partly closed valves, projecting joint material and other unsuspected obstructions have been located and removed. The reduced carrying capacity of a water main can be very serious and usually is not discovered until a partial failure of the water supply occurs. Consideration should be given to investigating the friction head loss in pipe lines, especially the older lines, to determine the actual monetary loss.

The greatly increased demand for water for locomotives in recent years has taxed pipe lines to the limit of their capacity. Additional material for larger mains is difficult to secure. By cleaning existing mains, their original capacity can be restored. The cost of cleaning mains four inches and upward in diameter with modern pipe-cleaning methods is much less than installing additional mains or replacing incrusted lines with new pipe.

Wells and Pumping Equipment

A considerable proportion of railroad water is secured from drilled wells, which vary from 50 ft. to several hundred feet in depth. A well supply is the only available source in some locations, while in other locations wells provide water of better quality than can be had from streams or surface supplies, and the water can be produced more economically.

The earlier deep-well installations were equipped with vertical displacement pumps of the single or double-acting type, operated by steam, gasoline or oil-engine power. The single-acting steamhead pump is an example of this kind of well equipment and was used to a greater extent than the other types. In recent years the electric motor-operated turbine pump has superseded many of the former pumps, and in locations where the older equipment is still used this type of equipment should be considered as modern practice.

The electric-driven motor turbine pump lends itself readily to automatic control; thus, attendance and operating costs are reduced. Pump houses may be relatively smaller, and in non-freezing locations the pumping unit is often protected only by a metal fence enclosure, instead of a house, with a resulting decrease in installation and maintenance expense as compared with the older types of equipment.

The production of water from drilled wells often decreases after several years of use, due to incrustation in the well screen or in the water-bearing formation. Several modern methods are now used to restore or improve the production, including the use of acid, dry ice, air pressure and mechanical cleaning, singly, or in combination.

The acid method is the most effective if a chemical analysis of the water or scale indicates that acid will dissolve the deposit. The acid usually used is 15 per cent hydrochloric, with suitable inhibitors to prevent damage to the equipment. The acid treatment of wells may now be secured on a contract basis from companies specializing in this work. In such cases the acid may be delivered to the well site in trucks and pumped into the well by the contractor's equipment.

The acid treatment is not effective in packed sand formations or where silt has accumulated in the well. In such cases, mechanical cleaning, surging, air pressure and bailing should be used to remove the obstruction and dislodged material from the well. Where well production has decreased, it is economical to restore the yield by suitable methods. Raising the pumping water level will result in savings in both power and maintenance costs.

Cathodic Protection

Several railroads report the use of the cathodic method to prevent corrosion in the interiors of steel water tanks below the water line. This method, in many cases, is more economical than painting. When tanks are painted, considerable out-of-service time occurs while the interiors are cleaned, painted and dried. This out-of-service time is expensive, and causes inconvenience when other means of providing water are necessary.

The cathodic method operates while the tank is in use, and out-of-service time is thus eliminated. This method is based on the passing of a low-voltage electric current from an anode suspended in the water in the tank, through the water, to the tank shell—the current being applied so as to make the steel shell electro-negative.

The principle of operation in the cathodic method of protection is as follows: The current flows from the anode to the cathode, dissociating hydrogen ions by electrolysis of the water. The tank shell, being electro-negative, attracts the positive hydrogen ions, which form a protective film on the interior of the tank below the water line. That portion of the tank above the water line must be protected in the usual manner by paint or other material. While this system of tank protection is of comparatively recent development, it is being used successfully and economically by a number of roads.

Conclusions

As outlined in this report, there are many obsolete water stations and component parts of stations that could be modernized to economic advantage. However, extensive modernization should be considered in the light of the decreased water consumption of Diesel locomotives, and the rapidly increasing number of such locomotives. At the present time some railroads are Dieselized to the extent of 50 per cent or more. This change in motive power will permit the retirement of many water stations and a change in the design of others. Likewise, the distance between water stations has increased from 25 mi. to 50 mi. and more due to the increased water capacity of present-day steam locomotive tenders. It appears that water stations for Diesel locomotives may be 200 mi. or more apart, or at division points.

Some intermediate water stations should be retained as reserve facilities, or as alternate points for water stops, to suit traffic conditions, and the stations so retained should be suitably modernized. Water stations for serving Diesel equipment will differ in some respects from stations now serving steam motive power. The large water columns and column supply mains now used to fill steam locomotive tenders will not be required.

Delivery of Diesel water can be made through smaller mains having several 2½-in. to 3-in. connections. These can furnish water at a rate of 300 to 400 gal. per min. to each unit at the same time. Under these conditions, higher pressures and booster pumps may be needed to modernize the water facilities for Diesel equipment. It may be necessary also to treat the water for Diesels by one of the demineralization processes in order to secure a water of the desired purity for the successful operation of the Diesel equipment.

Supplying water for modern locomotives, as well as for drinking purposes on cars, requires considerable study and planning to provide suitable quality and treatment control.

Committee Personnel

Howard E. Graham (chairman), asst. supt. w.s., I.C., Chicago; W. D. Gibson (vice-chairman), asst. engr., C.B.&Q., Chicago; H. D. Curie (vice-chairman), mast. carp., B.&O., Garrett, Ind.; John H. Babbitt, asst. div. engr., B.&O., Indianapolis, Ind.; R. E. Caudle, asst. engr. str., M.P., Houston, Tex.; G. S. Crites, div. engr., B.&O., Baltimore, Md.; V. E. Engman, ch. carp., C.M.St.P.&P., Savanna, Ill.; A. M. Glan-

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Discussion

Referring to that portion of the report dealing with cathodic protection, a member raised the question as to what effect variations in the amount of water in the tank would have on such protection. Chairman Graham answered this by saying he was of the opinion that variations of three or four feet in the water level would not have an adverse effect if the unpainted areas were exposed for only a few days, but felt that painting should extend a few feet below high-water line as a safety measure. Another member expressed the opinion that such protection could be provided without interruption to service and without draining the tank entirely. E. B. Tourtellotte (B. & M.) inquired whether there are locations where cathodic protection has not been successful. According to Mr. Graham there are locations where the process has failed, but these failures, he said, were due to lack of maintenance.

Next there was a query from a member as to whether the responsibility of maintaining cathodic protection systems rests with the water service forces or the electrical forces. Mr. Tourtellotte advised that inspections were made monthly on his road by an electrician, which included a report on the amount of water in the tank at that time, and that the replacing of the anodes was the responsibility of the electrician.

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One member suggested that electricians should do the actual work of maintaining the cathodic equipment under the supervision of the water service department.

Answering an inquiry regarding the effect that Dieselization of locomotive power has had on water supply and the number of stations required, Mr. Tourtellotte said that his road had been able to retire seven water stations due to Dieselization and that such stations now average 50 mi. apart. He also said that the cleaning of water mains during the war years had resulted in an increase in the flow of water through these lines of 55 to 63 per cent.

Construction and Maintenance of Shop and Enginehouse Floors and Runways

Report of Committee

R. W. Gilmore
Chairman

IN view of present high construction costs and the necessity that every dollar spent assure the maximum return, this is an important subject for consideration by this association. It is important, too, because in the last few years the wear and tear on shop and enginehouse floors has become much more severe, due to the heavier loads being hauled and the fact that they are moved by mobile cranes and tractors.

When floors become rough and uneven they are not only objectionable to work on, but moving loads and cranes cannot be safely operated over them. Shop committees are much more aggressive today and insist on good, well-drained floors.

This report is not an attempt to write a specification, but represents the ideas of various members of the committee as to the best practice in the construction and maintenance of the various, most commonly used types of floors.

The subject divides itself in two parts, first, floors in shops and enginehouses which are under roof and not subject to weather, and second, runways and platforms, not under roof. The various types of construction for floors considered in this report include brick, wood block, bituminous mixtures and concrete.

Brick Floors

Brick floors, if constructed of hard brick, are thoroughly satisfactory for shop floors which are not subjected to much heavy trucking. As long as the bricks are not too badly worn, and have not been treated with a mortar filler, they are fairly easy to surface; however, after the bricks have become worn they cannot be surfaced or patched satisfactorily. Brick floors should never be laid without a concrete sub-base. This base should be from 6 in. to 8 in. thick, depending upon the character of the sub-soil and the traffic to which the floor is to be subjected. The sub-base can be reinforced with mesh if desired, but this is not necessary where there is good soil beneath it. The top of the base should be 1½ in. to 2 in. below the bottom of the brick and this space should be filled with sand for a cushion. The sand should be carefully leveled off and the bricks laid on it by hand.

There are two methods of treating the joints between the bricks. The best method is to fill them with hot tar, thus preventing water and other substances from getting between the bricks. Another method is to cover the floor with cement grout and sweep this around over the bricks until the joints are filled. This latter method makes a better floor temporarily, but, after the bricks are worn, it is practically impossible to take them up and re-lay them.

Creosote-treated wood blocks are fairly satisfactory for floors in back and machine shops where they are not subjected to much water. They should never be used in roundhouses, as an excessive amount of water on the blocks causes them to swell, and the floor will soon become uneven. The construction of wood block floors follows closely that of brick, in that they should have an adequate sub-base of concrete. Some wood block floors have a sand filler under the blocks, but this is not necessary. Blocks can also be applied to the concrete base. The base is treated with a primer, followed by a ⅛-in. coat of coal-tar pitch. The blocks are laid after this has hardened, and should be set with the grain vertical. After they are laid, they should be given a top dressing of hot pitch filler.

Floors constructed of bituminous concrete or asphaltic compounds should never be used in roundhouses or shops where they are subject to oils, grease, or hot water, and their construction will not be discussed here.

Concrete Floors

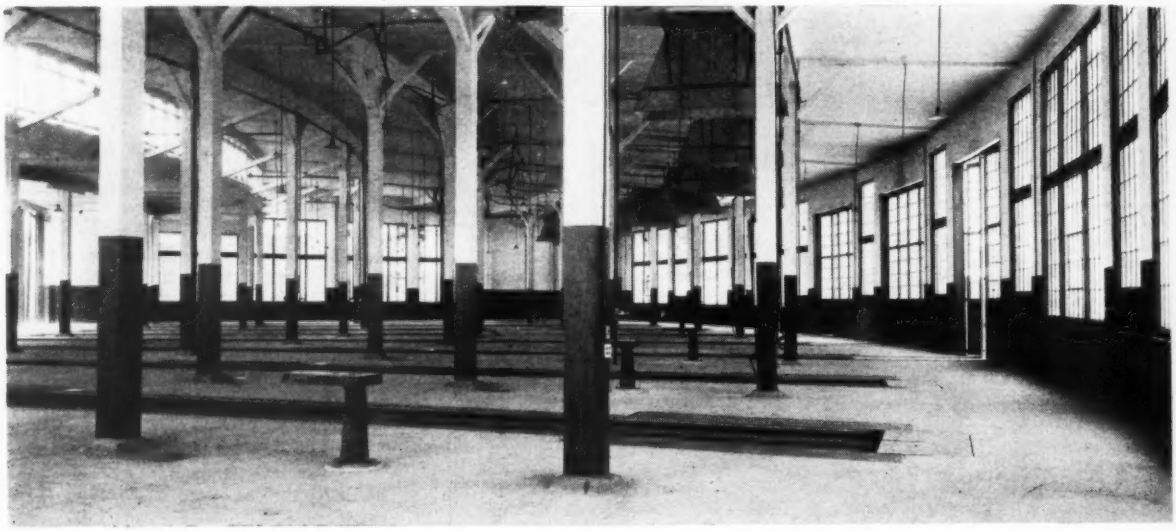
Concrete floors are the most satisfactory, if properly constructed. After their completion, however, it is almost impossible to make any improvement in them; hence, the utmost care should be taken to see that good workmanship and materials are used in their construction. It is recommended that every member interested in this subject read carefully the booklet published by the Portland Cement Association, titled, "Concrete Floor Finishes." In this it is stated that the essentials for good floor surfaces are:

Careful Selection of Materials
Skilled Supervision
Workmanship

Often, some of us have very little control over the selection of materials, these being governed by geography and other conditions. However, we can insist that the grading and cleanliness of the aggregates be reasonably

good. The supervision is up to us. The workmanship is also governed by our desire for better construction, and our ability, through leadership, to educate and instill the same desire in our staffs and our subordinates.

Most of the following discussion on concrete floors will be confined to those built on the ground, or to the topping of old floors. When floors are built on the ground, the sub-grade should be properly prepared. It should be well and uniformly compacted: all sod should be removed. Where it is necessary to fill, the fill should be built up in layers, not exceeding 6 in., and should be thoroughly tamped or rolled. This applies also to pipe trenches and holes for footings.



"Concrete Floors, If Properly Constructed and Maintained, Are the Most Suitable for Use in Railway Shops and Enginehouses"

Care should be used in the selection of the material to be used for these fills, which should not contain large lumps, frozen material, or anything which will rot.

Before the slab is poured, the sub-grade should be in a moist condition. It should be sprinkled prior to doing the work, but there should be no pools of water, and it should not be muddy or soft when the concrete is placed.

The thickness of the slab and the necessity of providing reinforcing in it depend upon the bearing capacity of the sub-soil and the traffic to which the floor is to be subjected. It is our recommendation that no floor be cast less than 6 in. thick, and that for heavy traffic the thickness should be at least 8 in.

Placing Concrete Floors

In the construction of floors covering large areas, some provision should be made for expansion. This can be accomplished by frequent construction joints or by using an asphaltic filler. Construction joints should be provided around all walls and columns.

The Portland Cement Association recommends that the concrete for the slab should be made of hard, well-graded aggregates and should contain not more than 6 gal. of water for each sack of cement. However, it is the opinion of your committee that water should be limited to not more than 5½ gal. It should be a plastic mix which can be placed without honeycombing or permitting excess water to accumulate on the surface. The actual mix of the concrete will vary to a great extent with the size and moisture content of the aggregate, as well as other factors. Therefore, it is not possible to give exact directions in this discussion. This information is given in detail in specifications of American Railway Engineering Association and the Portland Cement Association.

The concrete should be thoroughly compacted by vibrating or by tamping and spading. Tamping is very important wherever the top of the slab is to be the wearing surface. After this, it should be screeded and floated to proper grade, and then allowed to stand until all water sheen has disappeared before troweling. The use of a mechanical float permits the placing and finishing of much stiffer concrete and, at the same time, results in much better wearing qualities.

Topping Course

The majority of your committee believes that fairly good floors can be obtained without topping; however, the Portland Cement Association recommends topping courses be applied to all heavy-duty floors. This is pointed out in its booklet called, "Concrete Floor Finishes", referred to previously.

Space does not permit presentation here of all the information contained in this booklet, but some of the main recommendations follow:

"If the base has hardened, or the finish course is being applied to an old floor, it should be approximately 1 in. thick, and never less than ¾ in. In either case, the base should be thoroughly roughened before applying the topping. It should be well brushed, cleaned and free from all laitance and scum. The base should be thoroughly watered, but there should be no pools of water on the surface.

"The fine aggregate should consist of clean hard sand, all of which should pass a ⅜-in. sieve and only 5 per cent being permitted to pass a No. 100 sieve. The coarse aggregate should be graded so as to pass a ½-in. sieve, and only 5 per cent to pass a No. 8 sieve. It, of course, should be as hard as possible, and should be free from dust, clay, loam or vegetable matter, or any coating which would weaken the concrete."

The recommended mixture should be one part portland cement, one part of fine aggregate, and two parts of coarse aggregate, by volume. This, of course, can be varied, depending upon local conditions. In case the aggregate is very coarse, its volume may be reduced, but should not be less than 1½ times the volume of the fine. A maximum of 5 gal. of mixing water, including moisture in the aggregate, to a sack of cement, is recommended. The Portland Cement Association recommends at least 1½ min. in the mixer.

Application

Before applying the topping coat, a thin coat of neat cement grout should be broomed into the base surface. This should be so applied that it will not harden before the topping is applied. After pouring the top and striking off the surface to a plane about ¾ in. above the established grade, it should be compacted by tamping. This is very important, as a much denser finish is secured by thorough tamping. The surface should then be floated with a wood float or power floating machine. After the floating, steel troweling should be done, after the surface has hardened sufficiently to prevent any excess fine material from working to the surface. If a rough surface is desired, it should then be brushed with a stiff brush.

Although the P.C.A. recommends that no dry cement or mixture of dry cement and sand shall be sprinkled directly on the surface of the wearing course to absorb moisture or to stiffen the mix, this is a subject which is in dispute. Some members of your committee believe that, if properly handled, this is not detrimental and that "shakes" of some patented hardening material are

extremely beneficial if used properly.

When floors are to be subject to extremely hard wear, such as in wheel shops, etc., investigation should be made into the use of iron, natural and prepared topping aggregates or hex-grids.

Curing

The curing of the concrete floor is one of the most important operations in its construction, as a good floor can be spoiled if it is not properly cured. Curing can be done with curing compounds, or by covering the concrete with wet sand, pools of water, or wet burlap.

Your attention is called to the specification for heavy-duty floor construction and paving, dated June 1, 1945, as prepared by the Chicago, Milwaukee, St. Paul & Pacific. This specification is very good. The special points wherein it differs from the specification of the Portland Cement Association are that it calls for the use of air-entraining cement and graded trap rock aggregate. The Milwaukee's specification for screeding is also very good, in that it calls for screeding of the topping ¼ in. above the existing pavement, or the proposed grade, and that the topping be tamped down to grade.

Enginehouse Pits

This discussion would not be complete without reference to construction details for enginehouse pits. Formerly, pits were constructed with short wood ties supporting the running rails and wood jacking planks spiked to these ties. More modern practice is abandoning the wood ties and jack planks. Many roads are designing pits with concrete supports for the rail, the rail being held to gage by anchor bolts in the concrete. Concrete jacking pads are also being used.

Old pits with wood ties can be modernized when the floor is being rebuilt by the substitution of short pieces of rail in the wood tie pockets. These rail ties should be placed base up and the running rail clipped to them. Jacking pads can then be cast over the tops of these rail ties. The floor slab should be formed a sufficient distance from the outside of the running rail to permit access to the rail clip bolts. This space should be filled with a 6-in. by 6-in. treated wood plank.

Patching Concrete Floors

It is more difficult to patch concrete floors properly than any of the other types. For this class of work, reference is made to "Concrete Floor Finishes," of the Portland Cement Association, pages 21 and 22; also to Volume 43, "Journal of the American Concrete Institute," October, 1946, titled, "Wear Resistance Tests on Concrete Floors and Methods of Dust Prevention."

In the former, recommendations are made for patching, particular stress being put on the fact that patches should be cut out at least 1 in. in depth for the full area to be patched, and that no attempt be made to feather edge the patch; all corners should be square. Also, the material should be screeded off higher than the finished floor and tamped to place. The same attention should be given to curing as recommended previously. It is suggested for dusting floors that the top chalky surface be removed by scrubbing with steel wool pads and then that some type of commercial hardener be applied.

Runways and Platforms

Runways and platforms not under roof include walks or paved driveways, paths between various buildings, or various permanent installations and material platforms in shop areas. This is not meant to include station platforms or similar facilities. The committee believes that brick or wood-block runways, where exposed to the weather, are not satisfactory. For runways not subject to heavy concentrated wheel loads, and in climates where anti-freezing chemicals are used, bituminous material is satisfactory if there will not be an excessive amount of grease or oil dropping upon it. It is essential, however, that proper curbs be used to confine the material. Curbs can be constructed of concrete, treated wood, or old rail. For bituminous platforms a base of good crushed stone, at least 8 in. thick, and well rolled and drained, should be provided. This should then be topped with at least two inches of bituminous material, which should also be well rolled.

The committee believes that concrete is satisfactory for runways, just as it is for floors, and that in its construction the latest practice recommended for highway pavements should be followed. Some years ago it was considered good practice to pour a preliminary curb on each side of the runway, of concrete, and then fill between these curbs with the concrete pavement. The best practice now, if curbs are required, is to pour them integral with the slab.

The Chesapeake and Ohio Group at the B. & B. Convention Included: (Left to Right) R. L. Hecker, Asst. Supvr. B. & B., Saginaw, Mich.; B. J. Howay, Supvr. B. & B., Grand Ledge, Mich.; P. D. Haines, Supvr. B. & B., Saginaw, Mich.; H. M. Harlow, Asst. Gen. Supvr., B. & B., Richmond, Va.; A. E. Botts, Asst. Ch. Engr. (Maint.), Richmond, Va.; C. C. Sims, Supvr. B. & B., Hinton, W. Va.; and G. A. Allen, Br. Insp., Clifton Forge, Va.

B. & B. SECTION

Conclusion

In conclusion, your committee recommends that floors for shops and enginehouses, and runways, should be constructed of concrete, where possible. Concrete provides the best wearing surface, and while not easily patched, this can be done satisfactorily. In constructing these floors, particular care must be taken in the selection of the aggregates, limiting the water, proper tamping or compacting, and adequate curing. If all these details are taken care of, it is felt that one of the most satisfactory floors obtainable can be constructed.

We further recommend that runways and platforms be constructed of either bituminous or portland cement concrete—whichever is better suited to the climate and other special conditions involved.

Committee Personnel

R. W. Gilmore (chairman), gen. br. insp., B.&O., Cincinnati, Ohio; A. R. Harris (vice-chairman), engr. br., C.&N.W., Chicago; James J. Winn (vice-chairman), supvr. b.&b., B.&M., Boston, Mass.; C. Kenneth Avery, B. J. Many, Inc., Detroit, Mich.; R. E. Baker, supvr. b.&b., C.&E.I., Danville, Ill.; Maurice Coburn, sales engr., Indianapolis, Ind.; W. A. Huckstep, gen. bldg. supvr., M.P., St. Louis, Mo.; E. S. Joehnk, asst. engr. constr. & maint., B.&O.C.T., Chicago; Edward B. Jones, asst. supvr. b.&b., C.&O., Clifton Forge, Va.; S. E. Kvenberg, asst. engr., C.M.St.P.&P., Chicago; F. H. Masters, ch. engr. (retired), E.J.&E., Joliet, Ill.; W. J. Storen, W. J. Storen Company, Detroit, Mich., and J. L. Varker, div. engr., D.&H., Carbondale, Pa.

Discussion

M. Coburn (John D. Bolton Co.) opened the discussion by recommending the use of air-entrained concrete in all floors and run-

ways. Chairman Gilmore stated that air-entraining had been considered but omitted from the report since it was not the consensus of the committee to include it.

Joseph M. Giles (M.P.) stated that he had just completed pouring 27,000 sq. ft. of concrete based on specifications similar to those for floors contained in the report, except that air-entrained concrete was used. The project included 3/5 mi. of 10-ft. runways poured in two courses—a 4-in. base covered with a 2-in. topping. Reinforcement, consisting of 6-in. by 6-in. wire-mesh, was placed on top of the 4-in. slab immediately after pouring. Mr. Giles added that the construction was too recent to tell what results would be obtained, but felt that additional information would be available next year. The spacing of expansion joints was guided by the specifications for nearby highways and those recommended by the Portland Cement Association. The concrete was mixed and placed by company forces from mobile mixers mounted on cars, and surfacing was done by power floating machines.

Another speaker from the floor stated that, since air-entraining is comparatively new, it would take a few years before the results can be fully appraised. This speaker also expressed the opinion that all runways should be reinforced with some sort of temperature reinforcing and be of a single-course pour of 8 in. Chairman Gilmore offered the opinion that something should be done about the steel-wheel trucks so widely used in and around shops. Replying, one member stated that steel grids were used in runways on his road in some cases and had been successful in combatting the wearing effect of steel wheels. One of these installations has been in service for about 15 years.

Utilization of New Types of Material in Buildings

Report of Committee

GENERALLY speaking, there are relatively few building material items presently available for extensive and economic use which can properly be classed as distinctly new types of materials. Insofar as railroad building construction and maintenance is concerned, however, there are a number of materials which can be called new types because they have not heretofore been generally used.

The subject matter of this report should not be considered as completely covering the entire field of recent developments, effort having been made to limit the scope of the report to only such items as appear to possess qualities making them desirable for use by the railroads. Ten general classifications of new types of materials have been considered.

B. M. Stephens
Chairman

Glass Products

Problems of providing maximum light transmission and over-all pleasing appearance are being solved successfully and economically by the use of corrugated glass sheets, either of wire glass or plain glass, and by the use of glass blocks.

Corrugated wire glass is applicable for use as siding, side panels of saw-tooth type roof construction, enclosure material for elevator shafts and the like, and roofing in skylight, marquise and canopy construction Plain corrugated glass may be used for interior partitions and decorative glass panels and can be either smooth finished or sand-blasted on one or both sides.

Sheets of corrugated glass can be applied directly to structural framework, can be made water-tight, and can be used readily in conjunction with corrugated metal, corrugated asbestos or other types of siding and roofing.

Where the simultaneous provision of light transmission and ventilation is not mandatory, structural glass blocks are particularly valuable for use in roundhouses, machine shops, etc. These blocks readily take the place of conventional windows and, when used in connection with construction of exterior walls, have the added advantage of substantially increasing light transmission without materially disturbing the heating factors of the building as a whole.

Glass blocks are available in several sizes and designs, the several designs being for the purpose of meeting various problems and requirements of light transmission. From an architectural standpoint, glass blocks can be worked into attractive panel arrangements. Panels can include clear glass window sash when ventilation is required or small areas of visibility are desirable. Glass blocks are quite strong, but not load bearing, and are not subject to ordinary breakage. If broken, they are easily replaceable. Panels are readily cleansed by wetting, brushing and washing down with a hose.

Structural Glass

Structural glass exterior and interior finish is rapidly gaining in favor among designers. There are two types of this kind of glass; sheets of polished homogeneous material, and precast, load-bearing concrete blocks faced under pressure with polished structural glass. These products provide the designer with a means of achieving extremely attractive decorative effects, both exterior and interior, without sacrifice of economy. They are durable, not easily damaged, and are readily maintained and cleansed. The homogeneous sheets are quite suitable for dado and wainscot purposes and prefabricated sheets can be used for partitions and inside wall finish.

For construction requiring special treatment because of heating or air-conditioning, insulating glass units can be used satisfactorily. These units are formed by sealing dehydrated air between two or more panes of window or plate glass. The framework for these units must be of rigid design to prevent damage to them. Resistance of the units to the transmission of heat is high.

Heat-Absorbing Glass

Heat-absorbing glass is rapidly coming into general use in various types of shop buildings, storehouses, and other buildings. This is a blue-green colored glass that absorbs most of the sun's heat rays, admits an adequate amount of light, and substantially reduces glare and eye-strain. It is available in thicknesses of ⅛ in. and ¼ in. Ordinary glass ⅛ in. thick transmits about 87 per cent heat, while the same thickness of heat-absorbing glass transmits only 34 per cent; similarly, ¼ in. thick ordinary glass transmits 83 per cent heat, while the same thickness of heat-absorbing glass transmits 21 per cent. Heat from the sun is absorbed by this type of glass, thus raising the temperature of the glass until the point is reached where re-radiation equals the heat supplied by the sun. The absorbed heat is re-radiated from both surfaces of the glass, and it is assumed that one half goes to the outside and the other half to the inside.

Sun Screens

Although not a glass product, mention should be made here, apropos light and ventilation, of a relatively new window screening. This material was developed to provide a shading device, permitting passage of light and ventilation and at the same time protect against the direct radiant heat from the sun.

This sun screen, built on the principle of the venetian blind, makes it possible to achieve 80 to 90 per cent effective radiant-heat window insulation with practically no interference to ventilation, light or view. Louvres, of minute width bronze, 17 to the inch, are set at a fixed angle determined to give maximum efficiency with minimum in-

terference to view and light. The sun screen is installed in same manner as conventional window screening. Its use is particularly indicated in conjunction with air-conditioning installations.

Paint Products

Silicone resin paints have entered the field of heat-resisting and moisture-resisting materials. Some blends of the material will withstand continuous exposure to temperatures as high as 500 deg. F. and are ideal for such applications as ovens, smokestacks, exhaust manifolds, radiators and the like. Other blends of silicone resin paints are highly satisfactory for heat and moisture-resistant insulations for electric motors, high and low-temperature greases, heat-stable fluids and anti-foam compounds.

Water-base cement-binder paints have come to the forefront in the painting of masonry where conditions are such that oil-base paints cannot be successfully applied and where it is considered desirable to repaint every three or four years. These paints are normally furnished in powder form, to which water is added immediately prior to use.

As a rule, the ingredients of water-base cement-binder paints are more or less the same, and all of the many brands available will produce about the same results. An attractive decorative coating with three or four year's life can be secured on brick, stucco, concrete or tile walls by use of these paints. Many claims have been made with respect to the water-proofing qualities of these materials, but in most instances such claims are somewhat exaggerated and the materials will not stand up very well in most areas when used under abnormal conditions.

Oil-base cement-binder paints are actually normal oil paints with portland cement added. Such paints have been on the market for a number of years, but only recently have been used extensively. In normally dry climates of low humidity, oil-base cement-binder paints can be used successfully for the painting of masonry, provided the masonry has been properly sized with an alkali-proof sealer before painting.

Painting Masonry Walls

Masonry walls painted with oil-base cement-binder paints will not require re-painting as often as when water-base type paints are used. These products have about the same water-proofing qualities as water-base products. One prominent characteristic of the oil-base product is that it can be applied with lasting and satisfactory results directly to new galvanized metal without the necessity of allowing the metal to weather or of applying a special under-coater.

There have been some recent developments in fire-resistive coatings, although insufficient test data is presently at hand upon which to base recommendations for their use. Oil-base cement-binder paints have some value as fire-resistive coatings, particularly when the final coat is sanded. Several other special products recently placed on the market appear to have characteristics which tend to resist fire exposure.

Considerable progress has been made in the development of rust-inhibitors for use on metal structures. While most of these products were available before the War, there has been a decided improvement in their characteristics. These materials, of which there are a number equal in quality, can very often be used to good advantage.

Plastic Coating

While not exactly a paint, a war-born plastic paint-like product is now ready for general distribution. This product is a brushless plastic finish for applying to furniture, walls, floors, cabinets, wood trim, linoleum, etc. The material is wiped on with a cloth, touch dries in ten minutes and dries hard in six hours. No conclusive test data is yet available as to its lasting qualities or economy.

Closely associated with the subject of paint and painting is the recent development of a special pre-treatment for galvanized steel sheets. This pre-treating process forms a phosphate film on zinc surfaces, making it possible to apply paint to zinc-coated materials successfully without having to make allowance for a suitable weathering period.

Pre-Cast Concrete Products

Concrete blocks are being used extensively as substitutes for brick and hollow tile and in lieu of poured-concrete construction. Their properties permit savings in steel and formwork and afford economies in heating. The blocks have a high sound insulation value and are easy of installation and later removal, if desired.

There are two types of blocks; those similar in design to hollow tile, requiring mortar joints, and those with interlocking edges. The interlocking type is laid up without mortar joints, rigidity of the wall being achieved by filling the interstices of the blocks with concrete at regularly spaced intervals.

Leakage through walls, due to porosity of the blocks, generally requires the application of some type of waterproofing agents to the finished exterior wall surfaces.

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Pre-cast concrete roof slabs and beams of various types and designs have been on the market for a number of years but have only recently come into general usage. For permanent and fire-safe construction, use of these items may well be indicated, particularly for large projects where sizes can be made more or less standard.

Wash fountains and shower stalls of pre-cast concrete are in wide use in industrial wash and shower-room areas where a great many people have need for washing facilities at about the same time. These items are economical, durable, easy to keep clean and presentable, and are not difficult of installation.

Many large industries have successfully located central pre-casting plants for small concrete buildings. Forms are used over and over and pouring of the concrete is carried on under rigid control, thereby insuring soundness of construction. When small buildings, such as watchmen's huts, telephone booths, etc., are needed, they can be promptly shipped to the location required and erected quickly without the services of skilled labor, a feature that is becoming increasingly important.

Cement-Asbestos Products

Corrugated sheets of cement-asbestos are suitable replacements for corrugated metal and can be satisfactorily used for most types of railroad building construction requiring corrugated metal. Some of their advantages are high resistance to weather and temperature variations, ease and speed of construction, and non-combustibility. Flat sheets of cement-asbestos have substan-

The Waiting Room of the Erie's New Passenger Station at Akron, Ohio, is an Example of the Use of the Latest Types of Building Material in Railway Structures

tially the same characteristics as corrugated sheets, although they have much less strength.

Rigid asbestos shingles for building work are coming into wide use, both for roofing and for siding, there being a great variety of such shingles available. Use of shingles is indicated for remodeling the exteriors of frame buildings and for the replacement of wood shingles on roofs. Very attractive results can be obtained by the proper and considered application of shingles of this type.

Cement-Asbestos Lumber

Recent developments in the use of cement-asbestos lumber seem to indicate solution of the problem of providing a movable and salvable partition wall, and at the same time of achieving an appearance of stability and permanence. Partition units are formed by the use of standard studding to which the cement-asbestos lumber is attached by special fastenings. The studding in the wall units is not attached to the floor or ceiling, special floor and ceiling channels being used for the purpose of maintaining the units in place.

In addition to being almost 100 per cent salvable, the wall units have the advantages of providing an easily maintained surface, good resistance against the passage of sound, resistance against fire exposure, and a surface free of projections. Their use is indicated where space requirements in offices and similar places are subject to relatively rapid changes.

Impregnated cement-asbestos sheets are indicated for use where especially high-resistance to moisture, chemical fumes and gases is desired. Both surfaces of the sheets are treated with a bituminous compound, which acts as a seal against attack by destructive agents.

Structural Aluminum Products

Increased use of structural aluminum products is the result of efforts by designers to reduce weight of construction without impairment of strength, to achieve improvement in resistance to corrosion, and to present a pleasing architectural appearance. The aluminum used in the manufacture of structural shapes, etc., is in the form of alloys of various characteristics. In selecting aluminum products for use, therefore, consideration must be given to the purpose for which the aluminum is to be used.

Alloys are produced in many forms by drawing, extruding, rolling and forging. Structural shapes, such as angles, beams, tees and channels, and plates of relatively large size, are available. Also available are special architectural shapes, such as handrails, pilasters, mouldings, cornices and fascia, copings, thresholds, etc.

For Roofing and Siding

Aluminum sheet is also manufactured for use as roofing and siding. Roofing is made in the interlocking-shingle type, flat type with pre-formed joints, or corrugated-sheet type. Siding is available in flat or corrugated sheet, drop siding, or clapboard type. Some of the corrugated aluminum roofing and siding, however, is of too light a gage to be recommended for industrial use. In addition, aluminum is not recommended for use around engine terminals due to the attack made upon it by locomotive gases.

After continued exposure, the bright natural finish of aluminum becomes somewhat dull. To overcome this dulling, a special finishing process has been developed, which augments the natural film of aluminum oxide, thereby protecting the metal against weathering, etc. In addition, the finish permits the adding of color if desired.

Floor Finishes

Flexible floor coverings in general use at present include cork tile and sheet, asphalt tile, rubber tile, and linoleum, all of which have several disadvantages along with their several advantages. A new type of flexible floor covering made from both plasticized and unplasticized vinyl resin is becoming available in the form of floor tile or rolled floor sheet. Vinyl-resin floor coverings have all the advantages of other types of flexible coverings, with the added advantages of high strength, durability and resistance to attacks by greases, acids, alkalis, etc. The coverings can be furnished in a wide range of colors and their maintenance is especially easy due to their smooth finish and resistance to greases and other such agents.

In the maintenance of concrete floors and, in some instances, wood floors, use of one of several asphaltic-mastic type of floor resurfacers may be indicated. These products, sold under various trade-names, are more or less similar in characteristics and performance. They are useful in cases where concrete floors have become badly worn, pitted or broken and patch repairs are considered advisable instead of overall floor replacement. The material sets up to a fairly hard finish, is not difficult to place, and will stand a great deal of hard usage.

Admixtures

Several types of concrete admixtures have been developed in recent years for use in new concrete floor construction. These admixtures are for the purpose of securing durable, impervious and non-dusting surfaces for concrete floors subject to heavy traffic. Good resistance to attacks by destructive agents is also secured by use of certain types of admixtures.

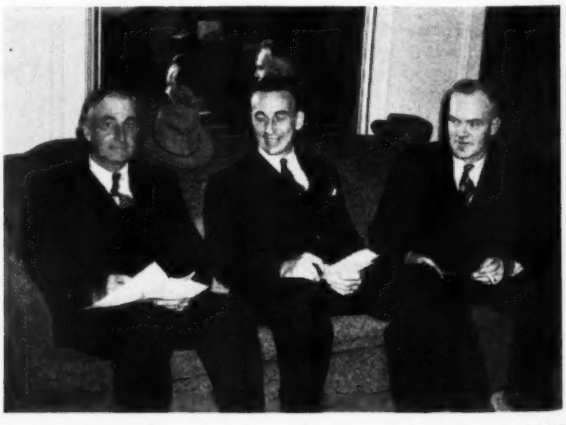
A new type of steel floor plate appears to have excellent possibilities for floor work. These plates are 12 in. square, flanged down on all four sides, and have many teeth-like anchors stamped from the wearing surface to provide bond to the concrete. Use of these plates is particularly desirable where floors are subjected to heavy and sustained travel.

Interior Wall Finishes

Enameled steel tile is available in baked enamel and porcelain enamel finish and a variety of colors. The baked enamel finish can be marred by contact with sharp objects. The porcelain enamel finish will resist harsh treatment and its surface will not craze or crack. The tile is particularly useful for corridors, washrooms and toilets, dining rooms, and similar areas.

Cloth-back wood veneer in 40 odd types is being successfully used for decorative

Talking Over Experiences on the Delaware & Hudson Are O. W. Stephens, Asst. Engr. Struct., Albany, N.Y.; J. L. Varker, Div. Engr., Carbondale, Pa.; C. Miles Burpee, Vice-Pres., Simmons-Boardman Publishing Corporation, New York, formerly with the D. & H.; and J. A. Doyle, B. & B. Mast., Oneonta, N.Y.



Representatives from Canada at the B. & B. Meetings Included This Group of Three Men from the Canadian National Railways' Central Region: (Left to Right) H. E. Clare, Rdm., St. Thomas, Ont.; F. J. Leinweber, B. & B. Mast., St. Thomas, Ont.; and G. R. Fisher, B. & B. Mast., Stratford, Ont.

purposes where an appearance of luxury and distinctive wall treatment is desired. The product is genuine paper-thin wood veneer glued under heat and pressure to cotton sheeting with water-resistant adhesive. The sheets can be hung to provide almost any design pattern desired.

Cloth-backed glass is very similar to cloth-backed wood veneer and can be used in much the same manner as the wood veneer. Thin sheets of glass are bonded to fabric backing and are then cut into small squares or rectangles. The material is available in 25 or more colors and 4 types—opaques, flat mirror, rolled pattern mirror, and metallic. Corners with a minimum radius of 5 in. may be turned without difficulty. The product is resistant to every surface attack to which sheet glass is resistant.

Sheet plastic on plywood provides a finishing material readily adaptable for many interior uses. The product is formed by fusing liquid plastic to plywood by heat treatment. The surface of the material is hard, smooth and polished and is easily maintained. The material should not be used in locations where it will be subjected to abnormal abuse and attacks by vandals.

Glazed-surface wood veneer sheets are substantially the same as sheet plastic on plywood and, therefore, are suitable for the same purposes. The glazed surface sheets are not so durable as the plastic sheets, but they can be used to good advantage in numerous locations where they are not subject to abuse other than normal cleansing operations.

Although fibre or composition ceiling blocks and wallboard panels and planks have been available for some years, use of these materials for interior re-decoration and modernization has not been general until recently. These products lend themselves readily to interior refinishing work at relatively low costs. Ceiling blocks, both acoustic and non-acoustic, present excellent means for refinishing ceilings. Attractive wall treatment can be achieved by use of wallboard panels or planks.

Metal Buildings

War demands developed considerable usage of pre-fabricated metal buildings. Buildings of many sizes and several types of pre-fabrication are available and have proved to be relatively economical and entirely satisfactory. Among their chief advantages are rapidity and ease of construction and adaptability to ready removal from place to place without loss of any part except foundation.

These buildings are generally either of the frameless type, in which the flanged panels are the load-carrying members, or the light steel framing type, in which the framework is covered with light-weight metal sheets. All parts of the buildings are metal, although wood sash and doors can be used if desired. Various combinations of floor plan can be achieved without difficulty and the overall appearance is not unpleasing.

Metal Roofing

Pre-fabricated steel roof decks of a number of types are now being used to good advantage under normal conditions. These decks can be substituted readily for pre-cast concrete and gypsum and usual wood decks and have the advantage of holding the roof framing costs to the minimum. One relatively new type of metal deck consists essentially of flanged interlocking steel panels with the flanges turned down. Insulating board and built-up roofing can easily be applied over metal decks.

Around terminals and other locations where corrosion and abrasion must be considered, asbestos-bonded steel sheets have particular usefulness. These sheets are made of steel or iron, coated with zinc in which asbestos fibres are imbedded while the zinc is molten. Final treatment consists of an application of a bituminous saturant under pressure.

Pre-Cast Gypsum Products

One pre-cast gypsum product—sheet-rock—has long been in use for interior partition work. Out of sheet-rock has been developed solid partition units and gypsum roof plank, which are merely sheets of sheet-rock glued together under heat and pressure.

Partition units are available in tongue-and-groove type or shiplap type, in thicknesses of 1 in. and 1½ in. These units are particularly useful for non-load-bearing partitions and where height and length of partitions are not excessive. Wood bucks and top and bottom plates laid flat against the panels add considerable strength and result in a pleasing appearance.

Roof Units

Gypsum roof units are two-ply, three-ply or four-ply, with the sheets in the plies being placed off-center to form ship-lap edges. Thicknesses are 1 in., 1½ in. and 2 in. and the units are treated with a water-resistant coating after the sheets have been glued together. The units will carry almost the same superimposed roof load as wood sheathing of comparable thickness, and are adequate replacements for wood as the decking for built-up roofs. They afford the added advantages of speed and economy in placing, due to their large size, and the further advantage of being rot-proof and vermin-proof.

Conclusion

The necessity for brevity in this report has made it impossible to do more than touch briefly on the many new building material items which can well be used in various types of railroad work. Conspicuous by their absence are remarks apropos to the many new developments in the heating, ventilating and lighting fields. There have been numerous new items and advances in these fields in the last few years, most of which are worthy of consideration for use in railway freight and passenger stations, shops, enginehouses, office buildings, service buildings and all types of roadway structures.

B. & B. SECTION

As partial basis for the substance of this report, reference was made to the report of the Building Committee of the American Railway Engineering Association, published by the association in Bulletin 463 of December 1946. Readers hereof desiring more detailed information about many of the products mentioned are referred to this A.R.E.A. committee report.

Committee Personnel

B. M. Stephens (chairman), arch: engr., T. & N. O., Houston, Texas; Henry G. Johnson (vice-chairman), asst. engr., C. M. St. P. & P., Ottumwa, Iowa; L. C. Winkelhaus (vice-chairman), arch. engr., C. & N. W., Chicago; K. W. Charlson, v.p. and ch. engr., Cunningham-Rudy Company, Detroit, Mich.; E. T. Cross, v.p., Armco Drainage and Metal Products, Inc., Middletown, Ohio; M. H. Dick, managing editor, *Railway Engineering & Maintenance*, Chicago; A. G. Dorland, asst. engr., E. J. & E., Joliet, Ill.; W. T. League, mast. carp., Penna., Toledo, Ohio; W. G. Mateer, pur. agt., E. J. & E., Chicago; W. V. Parker, research engr., U. S. P. H., Serv., Memphis, Tenn.; S. R. Thurman, b. & b. supvr., M. P., Nevada, Mo.; E. R. Wolf, sales engr., Marine Engineering & Supply Co., Los Angeles, Cal., and O. F. Womeldorf, div. engr. (retired), C. & N. W., Norfolk, Neb.

Discussion

J. J. Healy (B. & M.) opened the discussion by saying that he had been engaged in replacing steel sash in enginehouses with glass block, using company forces, and that the average output was 80 blocks per day per man as compared with 100 by nearby contractors' forces. On this job, he said, ventilation was being obtained by installing wood louvers in the upper portions of the block enclosures, covered on the inside by plywood covers operated from the floor level. These have been very successful, he stated.

R. W. Gilmore (B. & O.) expressed the opinion that, in order to obtain an output of 80 blocks per day, a wide area would have to be worked, since the slow drying of the mortar prevents the placing of more than three courses of blocks per day in the same panel.

J. L. Dougherty (W. M.) stated that the use of imitation brick siding for roadway buildings had advantages and presented a neat appearance. Another member added that such siding also provides some insulation, results in reduced maintenance, and is economical to apply.

E. B. Tourtellotte (B. & M.), in commenting on thermo-pane glass, brought out the fact that, in the northern part of the country, the falling of snow on such glass presents a problem because the snow does not melt as it does on other types of glass.

Development and Training of Supervisory Personnel in Bridge and Building and Water Service Forces

Report of Committee

THE subject of this report is very important to the railroads of our country, for certainly there must be continued an efficient and effective organization to maintain properly the bridges, buildings, and water service facilities of the railroads. In these days of ever-increasing speeds and of better and more costly equipment, and at a time when railway managements are determined to maintain and surpass the outstanding performance records of World War II, there is cast upon the shoulders of supervisory personnel the added responsibilities and problems of maintenance which these conditions have produced and which, we believe, will continue to become more complex in the years ahead. It is obvious then, that too much stress cannot be placed upon the proper training of the supervisory personnel in this particular field of railroad operation.

In this report we shall deal only with the term "supervisory personnel" as it applies to the bridge and building and water service forces. These forces are closely related, and on the majority of railroads are under the direction of the bridge and building supervisor. There are exceptions to this arrangement, however, especially on the larger roads, where the volume of work and uncertain sources of water supply require the full time of a supervisory officer to direct properly the activities of the water service forces.

A supervisor is, as his title implies, a "super-man"—one who is above the average of his fellows in ability, intelligence and aptitude for his work. He should be able to command the respect of those under his supervision to the extent that his orders and instructions will be carried out. It is very essential that he be able to plan and coordinate the work of the various gangs under him so that projects may be completed rapidly and economically. He must be able to understand and work by blue prints, and it is desirable that he have sufficient technical training to enable him to plan and lay out the work to be done by the forces under his supervision. He should be resourceful and able to cope with situations that are unusual, and also those of an emergency nature. All of these qualifications are developed by training and experience, and for this reason consideration of a suitable training program is of great importance.

Present Training Methods

Your committee has made an extensive survey of present practices on the railroads of the country governing the selection of supervisory personnel and has sought suggestions and expressions which might prove helpful and practical in the future as a guide in the development and training of this personnel. Questionnaires were sent to 58 of the leading railroads in the United States and Canada and 46 were returned in completed form. Approximately 500 super-

F. W. Hutcheson
Chairman

visors or master carpenters and assistants are employed by the roads reporting.

The results of the survey show that the vast majority of the railroads have no definite training program for supervisory personnel, except that of promoting the more outstanding men from the rank of gang foremen. That this plan has worked throughout the years is evidenced by the excellent record that these men have produced on their respective railroads. These men know how various jobs should be done because they have come up from the ranks and have actually worked on these jobs with their own hands.

A few roads follow the plan of appointing assistant supervisors to work under and be trained by the supervisor. These men may or may not be promoted from the ranks, but in many instances promising young men with technical training and some previous engineering experience are selected. At least one road has attempted to select promising young men from various sources, such as engineering parties, gang foremen, draftsmen, etc. These men are first made bridge inspectors for a period of time, then assistant supervisors, and finally, supervisors, provided, of course, they show the necessary qualifications.

So far as we have been able to determine, only three American railroads follow a systematic program of employing technical graduates for training as supervisory officers. Two leading roads have followed such a program for several years. Another road inaugurated such a program during 1946. The plan is a "Student Apprentice System," wherein technical men are trained, through actual work with the regular forces, in timekeeping, inspection, office work, etc. At the present time from about one-third to one-half of the supervisors on these roads are men who came up through the student apprentice system. The remainder were promoted from gang foremen. For the sake of morale among the men on the forces, it is the present policy to keep promotions from these two sources on about a fifty-fifty basis.

Officers of these roads report that the student apprentice system is working out very satisfactorily, and that it has produced, and is producing, excellent results. We believe this system has merit and recommend its consideration by those roads employing a considerable number of supervisory personnel. It probably will not be practical of application, however, on smaller roads where the supervisory personnel is limited to a very small number of men.

Qualified Personnel Needed

Several railroads are facing the task of replacing a large number of their supervisors during the next few years. This has been brought about by two factors—(1) Many men of advanced years have stayed on the job through the period of World War II at the request of managements because of man-power shortages, and are now beyond the average age for retirement. Under normal conditions these men would have retired at a more or less average rate, but now the turnover will be very heavy. (2) Several railroads have inaugurated retirement plans supplementary to that of the National Railroad Retirement Board, setting up more or less compulsory retirement at the age of 65 for officer personnel, including supervisors.

Obviously, these conditions are presenting a serious problem to those railroads that have not made provision for the proper training of qualified men for replacement. Furthermore this problem is certain to continue unless proper training methods are adopted, because there is every reason to expect that the retirement of men in this category will be above average for at least the next five years due to the abnormal conditions brought about by World War II.

Several roads report that they are now experiencing difficulty in obtaining qualified men to fill these positions, but there is little evidence that any definite steps have been taken on the part of managements to correct this condition or to plan for the future. Certainly this matter should be given serious consideration and immediate steps taken to overcome it.

Methods of Training

It is the concensus of railroad managements that previous technical training and engineering experience, while not absolutely essential, are highly desirable for supervisory personnel. Investigation develops, however, that to the present time only a few supervisors have had such prior training and experience. This is not to be construed in any way as a reflection upon the qualifications or ability of those hundreds of men now filling these positions in such

a capable manner all over the country.

In considering a plan of training and orientation for prospective supervisory personnel who might be graduates from various technical and engineering schools, it should be borne in mind that at the present very few such young men find their way into railroad service. Prior to World War I the railroads were among the largest employers of these graduates, but following this period other fields, such as sanitation and highway work, forged to the front. The railroads, however, were still able to obtain sufficient personnel for their needs. When the depression came in the early Thirties, it was necessary to curtail the hiring of new men, and in many instances to furlough some of those already on the rolls. When, during the war years a sizeable number of young graduates might have been employed, such were not available.

With these as contributing factors, it is apparent that there has been in recent years a lessening interest on the part of engineering graduates in railroading as a career. There is also the fact that other industries have and are continuing to offer better salaries than the railroads, at least in the initial years of employment. This situation deserves consideration by railroad managements if they expect to attract the more outstanding graduates of engineering schools.

"Too Much Stress Cannot Be Placed Upon the Proper Training of the Supervisory Personnel in the Railway Bridge, Building and Water Service Forces"

Program Suggested

It is suggested that a training program for such employees might be handled on the following basis: First a period of 12 months or longer should be spent in close contact with the actual work, either working with the gangs or, if this is not feasible, working as an assistant to the supervisor—not assistant supervisor. With this status the trainee could be assigned to various projects and not be limited to the work performed by one gang. During this period he would have opportunity to become acquainted with the general routine office work required of the average supervisor. When this first period of training is over he should be in position to know whether or not he desires to continue in this department, and should be thoroughly interviewed to that end. The next period of at least six months or longer should be spent as a draftsman in bridge, building and water service work. While at this he would become familiar with the system designs and general practices of his road with regard to its bridges and other structures.

From this point the next step should be to the position of bridge inspector on a given territory. We believe this period should be for at least 12 months, and preferably longer. During this time he would have opportunity to assist in the preparation of annual maintenance programs covering not only the bridges, but the entire category of this department. There would also be an opportunity to observe the problems of maintenance and construction resulting from various seasonal changes, as well as those of performing work under traffic without undue delay to train movements. Much valuable information assimilated during this period would be helpful in the future.

If the technical graduate has properly applied himself to the above training program and shows the required ability and interest in his work, he should now be ready for a position as assistant supervisor, provided there is an opening. He would then remain in this position until such time as there is a vacancy as supervisor. This period should be regarded as probably the most important in the entire program, as here he would first begin the handling of men, the planning of work, and the shouldering of responsibility.

Salary

The above is merely a suggested general plan, and is sufficiently flexible to provide for the necessary changes to cover conditions pertinent to locality and management, as well as the aptitude and ability of the individual. There are many details to be worked out under such a plan. To mention only one, there is the question of wages. We believe the initial salary should be sufficient to attract young men of outstanding ability and scholastic records, with at least some faculty recommendation from their particular schools or colleges. There should, of course, be progressive increases in salary through the various stages of training and development. This feature is extremely important, as many industries canvass the graduates of technical schools annually and offer attractive propositions to those of outstanding ability.

When promoting foremen or other men without technical training to supervisory positions, the committee feels that it would likewise be desirable to have these men serve a period as bridge inspector and assistant supervisor before being elevated to the position of supervisor. It has always been quite a long step between the qualifications required of a foreman and those required of a supervisor, and under present-day methods and practices, the gap is even wider. It is, therefore, desirable and practical that men promoted to supervisor have additional training and knowledge other than that derived from actual gang experience.

For those without technical training, a correspondence school course in railroad engineering should be encouraged. Several such courses are available, and a diploma received after completing any one of them is an indication of considerable effort put forth on the part of the student, and the assimilation of much valuable technical knowledge. To encourage the completion of such courses, it might even be practical for the railroads to refund a portion or all of the tuition fee, provided a diploma is received and, of course, that the man completing the course is still in employee relationship at that time.

Conclusions

It is apparent from the survey conducted by your committee that there is a very definite shortage on many railroads of the country of properly trained and qualified men to fill supervisory positions. At no previous period in history has this shortage been so acute. In spite of this situation, only 4 of the 46 roads replying have made any attempt to set up a definite training program for the benefit of this particular group. Some are considering such a step, but no definite action has yet been taken.

It is further evident that, due to conditions brought about by World War II, and also to the establishment of compulsory retirement programs by many roads, the requirements for replacements of supervisory personnel will be considerably above the normal average for at least the next five years.

Training programs are feasible and practical, as is evidenced by the satisfactory results being accomplished on those roads which now have such programs. Other industries have also been successful in such training programs for the development of supervisory personnel. Therefore, it is reasonable to assume that more roads should find such programs equally successful.

It is also evident that such training pro-

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grams in the case of technical graduates would be the means of qualifying at least a few men for positions of greater responsibility and importance, such as assistant division engineer and division engineer, after they have served in other supervisory capacities.

In view of these facts, your committee recommends that this report be brought to the attention of railway managements for their earnest consideration, and that they be urged to take immediate steps toward the inauguration of some definite plan of development and training for this branch of supervisory personnel. The benefits derived from such a step, we believe, will more than compensate the railroads for the expenditure required.

Committee Personnel

F. W. Hutcheson (chairman), supvr. b. & b., C. & O., Newport News, Va.; Jesse S. Hyatt (vice-chairman), ch. engr., C. N. S. & M., Chicago; O. W. Stephens (vice-chairman), asst. engr., struc., D. & H., Albany, N. Y.; N. C. Ailes, asst. val. engr. (retired), D. & H., Berlin Center, Ohio; R. J. Bruce, asst. engr., M. P., Bonne Terre, Mo.; W. H. Bunge, asst. engr., G. C. L., Houston, Tex.; H. M. Harlow, asst. gen. supvr. b. & b., C. & O., Richmond, Va.; C. A. Hughes, supt. b. & b., E. J. & E., Joliet, Ill.; C. E. Jacobson, engr., b. & b., A. & W. P.—W. of A. & Ga., Atlanta, Ga.; P. L. Koehler, asst. supt., C. & O., Peach Creek, W. Va.; R. H. Morrison, prin. asst. engr., B. & A., Houlton, Me.; and L. E. Peyser, prin. asst. arch., S. P., San Francisco, Cal.

Discussion

W. F. Martens (A.T.& S.F.) opened the discussion by saying that he considered the development and training of supervisory employees the greatest problem now confronting the railroads. He added that the initial attack against this problem should be made by the employing officer always keeping in mind the prospective employee's supervisory capabilities.

In reply to a question from the floor as to whether union contracts which some roads have with their employees were presenting any obstacles to training programs, Chairman Hutcheson stated that a few road mentioned difficulties of this nature, but that none were specific about them.

J. S. Hancock (D.T.& I.) spoke of the difficulty his road was having in getting technically-educated men. He said that, in canvassing various engineering schools, it was found that the type of man desired was not interested in railroad work. He illustrated this point by telling of one college employment office which, after bulletining 162 railroad positions as available, had only three of them accepted by graduates. He said that college men had acquired the general impression that seniority, rather than ability, governed promotion, adding he did not believe that railroads will get many men interested in their work until such an impression is dispelled.

F. M. Misch (S.P.) stated that he thought the committee had prepared a good report, but wondered if it could be sold to the management. He said he thought the problem was aggravated by the fact that about 55 per cent of the present force on his road was just holding on while working toward a pension. The remainder of the men, he added, are not capable of assuming greater responsibilities. He stated that in the face of these difficulties, "we *must* develop our trainees."

Glued, Laminated Members in Bridges

Report of Committee

Lee Mayfield
Chairman

LAMINATED structural timbers, made by gluing thin material together to provide necessary length, width and thickness, are finding their way into many new fields of usefulness. One of the newest fields is in railroad bridges. One of the first uses in a railroad bridge involved 11 stringers installed, in October, 1944, in one panel of a creosoted timber ballast-deck trestle for test purposes. The stringers were made of 21 thicknesses of ¾-in. southern yellow pine (short leaf), Grade C and better. Finished dimensions after fabrication were 7 in. by 16 in. by 14 ft. 2 in. Before installation, the glued, laminated stringers were creosoted with a 15.5-lb. per cu. ft. retention.

This project was on the Texas and Pacific, near Woodlawn, Tex., and was carried out during the war under the sponsorship of the War Production Board. The installation was made under the guidance of the Forest Products Laboratory, Madison, Wis., and the laboratory and the railway have maintained observation of this bridge since that time. It is reported that the stringers have shown no evidence of delamination or deterioration.

In September, 1945, the Southern installed some laminated stringers, caps and posts in an open-deck trestle near Alexandria, Va. All lumber used was southern yellow pine, except for three plies of ¾-in. red oak on the bottom and top of each cap. All members were treated by the Rueping process, after gluing, to an average retention of 7.76 lb. per cu. ft. of 80-20 creosote-coal tar solution. The members are inspected regularly and the last inspection showed them all to be in good condition. Other railroads that are testing laminated bridge members include the Atlantic Coast Line, the Chesapeake & Ohio, the Spokane, Portland & Seattle, and the Southern Pacific.

Lumber

The grades of lumber used in glued, laminated bridge members should be those required for the stresses used in design. The grade in the middle three-fifths of the depth of a beam may be one grade lower than in the upper and lower fifths, but should be free from warp, which would prevent uniform spreading of the glue and the surfaces of adjacent laminations from being brought into close contact. The material may be either flat grain or edge grain, but preferably all flat grain or all edge grain. If desired, the bearing surfaces may be made from lumber with a greater cross grain compressive strength than the innermost section. The bearing surfaces should be of a sufficient number of plies to produce a thickness of three to four inches. For economy, the individual plies of a laminated member should not be less than three quarters of an inch thick, and they should not be more than two inches thick. Two inches is the maximum practical thickness for curing, seasoning and preparing for gluing. The thinner plies result in an increased number of pieces to be machined and more glue lines, both of which will materially increase the cost. In narrow built-up members, the width of each lamination is usually the full width of the member, in a single piece. In wider members, the width of a lamination may be made up to two or more pieces, edge glued. Random widths, 4 in. and wider, may be used. For good appearance, top and bottom laminations should be of single-width pieces, or of strips glued together edgewise.

Joints

Longitudinal joints may be scarfed or butted, except that there should be no butted end joints in the surface laminations on either the tension or compression faces. Scarfed joints should be scarfed at a slope of not more than 1 in 12, except that the slope of the scarf need not be less than the

slope of grain of the grade of the lumber at the joint. The slope of the scarf should be free from knots or pitch-pockets. The scarfed ends should be completed and set, and smoothed to a uniform thickness with rest of piece before assembly into the member, unless means are used to secure the scarfed ends firmly in place during gluing. Scarfed end joints in corresponding laminations near compression and tension faces should be staggered longitudinally—center to center of joints—by at least 24 times the thickness of a single lamination. Butted end joints in adjacent laminations near compression and tension faces should be staggered by at least 40 times the thickness of a lamination. There should be no more than one joint in any three adjacent laminations in any longitudinal section equal in length to 24 times the thickness of the stock.

An Example of the Use of Laminated Members in the Stringers, Caps and Posts of an Open-Deck Trestle on the Southern near Alexandria, Va.

Machining Lumber for Gluing

Wood surfaces that are to be glued must be smooth and true, and machining must be done just before gluing to prevent distortion of the surfaces. Surfaces made by a saw are usually rougher than those made by planers, jointers and other machines equipped with cutter heads. However, recent perfection of saws for this purpose has made it possible to edge glue sawed joints more extensively, thereby effecting a saving in labor and material. Machine marks, chipped or loosened grain, and other surface irregularities are objectionable. To produce satisfactory results, the maximum variation in thickness in any individual lamination should be restricted to 0.01 in., with every effort toward a 0.005-in. tolerance.

The glue used must be moisture-proof and not affected by the preservative treatment. Such glues include resorcinols, phenols and resorcinol-phenol blends. The time between mixing and using, and between spreading the glue and the application of pressure, varies with the glue and conditions of its use. Manufacturer's directions should be followed. The glue should be spread at a rate of 45 to 65 lb. per 1,000 sq. ft. on all faces which are to be glued together, including the inner faces of the outer laminations. Double spreading of each lamination, except the outer ones, insures the wetting of all wood surfaces to be glued.

Moisture Content

The moisture content of the wood should be between 8 per cent and 15 per cent for the best results. Generally, 10 per cent to 12 per cent is preferable. The temperature of the glue and gluing room should be in accord with the directions issued by the manufacturer.

Uniformity of pressure is essential in the gluing process. Clamps should bear on a caulboard, or pressure-distributing board or plank, of sufficient thickness to distribute the pressure uniformly. With ¾-in. cauls, a clamp spacing of 9 in. has been found to produce adequately glued joints. Smoothness of surface and freedom from warping and cupping are of the utmost importance to a good glue line. Pressure is required largely to make the contact. With a completely true and even surface, comparatively little pressure would be required, but pressure heavy enough to flatten out a cupped surface would require pressure varying in intensity over the surface, with a resultant glue line of variable quality. Generally, a pressure of 150 to 200 lb. per sq. in. is desirable and sufficient to insure a good joint. Ordinarily, a glued member can be handled after 24 hr. and will carry its calculated load after a week or ten days. These provisions should be specified, however, for each particular case.

After curing, all members should be planed to the specified size and cut to the specified length. If desired, arrangements can be made with the manufacturer to prebore and pre-frame the members according to the railroad's plans and specifications. This may be a desirable procedure before the members are treated.

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Strength

The properties of parallel-grain construction in glued, laminated members are essentially the same as those of solid wood, but laminated members, if well constructed, are usually more uniform in strength properties and less apt to change shape with variations in moisture content. One of the advantages of laminating is that the type and position of defects admitted can be controlled. Laminated construction also offers the advantages that high-grade, strong material may be so placed in a member that its high strength can be more effectively utilized, while low-grade, weak material may be so placed that its low strength is not deleterious. To date the practice has been to eliminate large holes, knots, dote, wane, and similar defects by cross-cutting or ripping. Laminating, of course, cannot make non-durable species durable, but the non-durable or weak pieces can be eliminated. Tests on laminated bridge members have shown that the same strength can be obtained as in solid members.

Treatment

Tests have indicated that, with certain modifications in the curing process, lumber treated with salts or creosote can be glued with many of the highly water-resistant resins. However, where heavy retentions of oily preservatives have been used, definite interference with subsequent gluing has been noted. Consequently, modifications of treatments may be necessary when the lumber is intended for laminating after it is treated. The problem of treating after gluing has been fairly well met and solved. Many glued-up members have been successfully pressure treated when good waterproof glues are used, such as, resorcinols, phenols and resorcinol blends. The compatibility of glue and kind of treatment with regard to acidity and alkalinity must be known. Not all glues and preservatives are compatible; the only way to find out which goes with which is to run tests. Fortunately, many such tests have been run already and the results may be obtained from glue manufacturing companies, treating companies and government laboratories. Before either treating lumber which is to be glued, or gluing lumber which is to be treated, the glue manufacturer, treating plant and Forest Products Laboratory should be consulted as to the proper procedure.

Cost

The number of laminated members in use in railroad bridges is too limited to permit full determination of their costs compared

From the New England States Came This Group of B. & B. Men: (Left to Right) H. J. Aliberti, Asst. Supvr. B. & B., Maine Cent., Portland, Me.; R. H. Snow, Gen. Fore. Plumb. & Heat., Maine Cent., Waterville, Me.; F. R. Spofford, Asst. Div. Engr., B. & M., Dover, N.H.; J. J. Healey, Asst. B. & B. Supvr., B. & M., Boston, Mass.; and E. B. Tourtellotte, Supvr. B. & B., B. & M., Greenfield, Mass.

with solid timbers. In general, the initial cost per M. feet of laminated timbers will be greater than the cost of solid items, especially in the smaller sizes which are relatively cheap in solid form. This is because the raw material itself is the chief element of cost.

The lumber used for laminating must be machined before gluing and raw material is lost in the operation. Furthermore, the cost of a specialized plant and equipment, and of the glue, must be added, and only a lesser cost of rough lumber can offset these added manufacturing costs. Although initial costs on the basis of footage will usually be higher for laminated timbers, true comparative costs can be appraised only in the light of long-run installation and maintenance costs, and total service life.

The greater dimensional stability of laminated timbers and their great resistance to splitting and checking mean less spoilage before installation and longer service life, with reduced maintenance and replacement costs. Relative costs will be further affected by overall size. Costs per M. feet of laminated timbers will be more or less constant, regardless of size. Solid timbers of large size, on the other hand, will be more costly per M. feet than will smaller sizes.

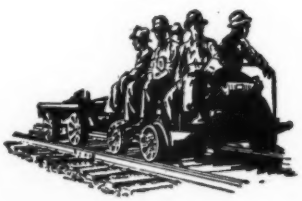
Mill-run lumber of random sizes, lengths and grades can be purchased at a much lower cost per M. feet than where the sizes, lengths and grades are specified. This lumber can then be sorted and graded, and only that meeting the required specifications used for laminated bridge members. The remainder can be used either as solid member or laminated members for other railroad purposes. This feature, alone, will have a greater tendency to reduce the cost of laminated bridge members to one comparable to solid members than any or all other factors combined.

The necessity for bridge renewals in most instances is spot deterioration. A large percentage of the salvaged lumber could be re-sawn, culled and machined for building laminated bridge members. Much of the timber would be of a better grade than can now be obtained, and would be available at a low cost compared with new material.

Advantages

Large solid timbers for use in railroad bridges are becoming more difficult to procure each year. They contain some visible defects and may contain hidden defects, all of which will impair their strength and usefulness. The scarcity of the large dimensional timbers may become so acute within a few years that the renewal of timber trestles with timber will be out of the question, and other material will have to be used entirely for this work. The railroads in this country have hundreds of miles of timber trestles with a remaining service life of 15 to 30 years. These trestles, along with hundreds of miles of older structures, will require an enormous amount of repair timber if they are to obtain their maximum economic life. It is doubtful whether after a few years sufficient repair material of solid lumber will be available at a cost that will not be prohibitive. Where then can repair material be obtained? The answer may lie largely in laminated members.

Good glue and good lumber are not all that is required to produce good laminated members. Good equipment, as well as a technically-trained man for each laminating plant, are also essential for a high-class job. Otherwise, the product will not be a credit to the manufacturer and will not be reliable as a structural element.



The railroads are proceeding in the right direction by securing the services of the glue manufacturers, the lumber industries and wood products manufacturers, under the supervision of government laboratories. If they will continue under the workmanship and advice of these experts they will, in due time, be rewarded for their patience and perseverance. On the other hand, if they attempt to produce or have produced laminated members in a haphazard manner, the results may be bitterly disappointing.

Conclusion

It is not the intention that this report be construed as specifications, but rather as a brief description of the method of manufacture of glued, laminated members for railroad bridges. From information available, all installations to date have been for test purposes. Sufficient data is available from laboratory tests, however, to prove that laminated members can be made with the desired strength and durability, and in sizes and lengths greater than is possible from solid timber. These members can be made of any species of timber or of a combination of species where the moisture coefficients of expansion are approximately the same.

The committee is indebted to a number of manufacturers and to the Forest Products Laboratory for much of the information contained on this report.

Committee Personnel

Lee Mayfield, (chairman), res. engr., M. P., Houston, Tex.; V. L. Leak, (vice-chairman), gen. fore., b. & b. and w. s., St. L.-S.F., Tulsa, Okla.; W. F. Arnold, tech. dir., Koppers Company, Inc., Orrville, Ohio; E. H. Barnhart, div. engr., B. & O., Garrett, Ind.; A. E. Bechtelheimer, engr. of br. (retired) C. & N. W., Chicago; G. W. Benson, supvr. b. & b. C. of Ga., Macon, Ga.; R. R. Clegg, dist. sales mgr., American Lumber & Treating Co., Chicago; Warren R. Hedden, gen. supt., Roberts and Schaefer Company, Chicago; Fred M. Lehrman, engr., Reynolds Metals Company, Chicago; C. V. Lund, asst. engr., C. M. St. P. & P., Chicago; Geo. Ross, br. fore., M. C., Niles, Mich.; Frank Tackler, gen. b. & b. fore., A. T. & S. F., Chanute, Kan.

Discussion

Chairman Mayfield augmented the report by stating that, since the printing of the report, he had learned that plies up to 3 in. thick could be successfully glued in lieu of the 2 in. maximum mentioned. President Campbell expressed the opinion that laminated members might be the answer to the present difficulty of getting large sizes of timber. Mr. Mayfield said that those interested could obtain the latest information on laminated members, as well as definite specifications, by contacting the Forest Products Laboratory, Madison, Wis.

Safety Measures to Protect Employees Within Buildings Against Fire and Accidents

Report of Committee

THE subject of this report covers practically an unlimited field, and is of such scope that the committee did not find it possible within the space allotted to deal with the various measures involved in as much detail as it would have liked. This report, therefore, is necessarily of a general nature.

For convenience, the report is divided under two general headings—"Fire" and "Accident," and protection therefrom.

To discuss the protection of employees in buildings against fire is rather difficult without going into the realm of fire prevention, detection, and extinguishment. However, we will assume that these three things have been adequately taken care of and will deal only with the prevention of injuries and fatalities resulting from fire and panic.

However remote we may consider the possibilities of tragedy or disaster on our own properties, such things as the recent epidemic of hotel and industrial fires, climaxing, so to speak, with the Texas City disaster, should have done more than anything else to make us realize our responsibilities as employers and public servants.

Exit Requirements

The fire-safety of building occupants probably depends more on the ability to evacuate the building in case of fire than on any other factor. Of the approximately 10,000 deaths due to exposure to fire in the United States each year, a very large majority can be traced directly to inadequate or blocked building exits.

Exit requirements depend on several factors, including the occupancy of the building, the fire hazard presented by the building's construction, and the materials and processes contained within the building. A principal factor is whether or not the building is equipped with automatic sprinklers.

The following exit requirements should be considered as minimum requirements for existing structures: In a building of high-hazard occupancy, that is, where there is danger of rapid burning, explosion or toxic gases, no portion of the working area should be more than 75 ft. from an exit; for medium hazard or moderate burning without explosion or toxic gases, 100 ft.; and for low hazard with automatic sprinklers, 150 ft.

It is generally recommended that for high-hazard occupancy, where the floor area of any story exceeds 2500 sq. ft., two exits should be provided as remote as possible from each other, and assuming an occupancy of one person for each 100 sq. ft. of gross floor area, the exits should provide 22 in. of width for each 30 persons. However, when the stairways from upper floors are enclosed by fire-resistive materials, and the building is equipped with automatic sprinklers and classed as a low-hazard occupancy, these requirements may be reduced by 50 per cent, but any work area should not have less than two exits. When the foregoing requirements cannot be met in older existing structures, the population of these structures should be limited.

S. L. Chapin
Chairman

All exits should be plainly marked, and illuminated if necessary, so they will be visible from any part of the work area, if possible. If it is not possible to see certain exits, adequate directional signs should be provided.

Material should not be allowed to accumulate near exits or to block passageways leading to them. Exits should not lead to other enclosed areas, such as enclosed court yards, and when it is necessary that they lead to alleyways, precautions should be taken to see that such areas are kept clear.

On some older multiple-story buildings, narrow and steep outside wood stairways and ladders are to be found. These should not be considered as fire exits under the recommended minimum requirements as they are not safe for the purpose. Also, elevators should not be considered as a means of emergency escape.

Stairways—Windows

Inside stairways, including all landings, should be enclosed with fire-resistant material and be accessible through outward swinging fire doors of the self-closing type. Stairways should be accessible without the necessity of passing through any locked rooms and, when necessary, direction signs should be provided.

Open outside stairways or fire escapes should be regarded as nothing more than a secondary means of escape and, generally speaking, should not be used on buildings over four stories in height. For frame buildings, outside stairways of wood construction should not be allowed on buildings over three stories in height, and then only for low-hazard occupancy buildings.

Outside stairways or fire escapes should not be less than 29 in. wide between hand rails, and a width of 44 in. is to be preferred. In any case the width should conform to the exit requirements previously given, excepting in existing buildings, when remodeling would be extensive, 40 in. would be acceptable as two exit units and 36 in. as one and one-half exit units. Stairways should not exceed 45 deg., and a 10½-in. tread with 7½-in. riser is recommended.

Where windows exist adjacent to outside fire escapes, they should consist of wire glass in metal frames for a distance of 15 ft. horizontally from any portion of the fire escape and for a distance of 35 ft. below and 10 ft. above, measured vertically. Much to be preferred are outside stairways within so-called "smoke proof" towers constructed of fire-resistant materials and separated from the building by a fire wall, with the entrance from each floor protected by a fire door.

Fire Doors—Warning Systems

Fire doors should be of either an automatic, or self-closing, type; they should be reasonably smoke tight and should correspond at least to the fire resisting qualities of the wall or partition in which they are placed. They should be prominently marked and precautions should be taken to see that their self-closing, automatic features are properly maintained.

Generally speaking, some type of fire warning system should be provided in any building containing 40 or more persons, and, if manually operated, the sending stations should be prominently marked and kept clear at all times. Approved closed-circuit electric alarm systems are recommended and should be connected with the local fire department or central protection agency. Of new interest is an industrial smoke detector recently placed on the market, designed to detect fire in storage or record vaults, or other locations in industrial plants or buildings. This detector, which has an enclosed light beam, operates on the principle of a photo-electric cell. Air samples are continuously drawn into a detecting chamber where, at the first sign of smoke, an alarm is sounded.

Regardless of how adequate the means of escape and fire protection, or the type, use and size of the building, the evacuation of the building should be carefully planned, and as much information as necessary conveyed to the occupants. To minimize the possibility of panic in large-occupancy buildings, regular fire and emergency drills may be held. Such drills should be carefully planned and carried out under rigid discipline. In some cases the type of work being done may preclude the possibility of

such drills, and printed instructions distributed to the occupants and posted in prominent places, with a trained exit organization, may be the answer. Such an organization might, in large buildings, consist of a leader, floor monitors, exit guards, etc. Each of them and those under them should be assigned to specific tasks, such as opening exit doors, regulating traffic, assisting people down fire escapes, etc.

Spread of Fire

While precautions to prevent the spread of fire may properly come under the heading of fire prevention, the subject is so closely allied to protection of personnel that it is believed there should be some discussion of the subject. While the term "fire proof" is often given to buildings constructed of non-combustible materials, the term is actually misleading. Such buildings should be more properly termed "fire resistant," and their fire resistance depends on their ability to withstand damage caused by the burning of the combustible materials within them. Even within a so-called "fire proof" building, precautions to retard or prevent the spread of fire should not be overlooked.

Fire may be spread from one unit to another in the type of building referred to through ventilating ducts, wall openings, elevator shafts, stair wells, etc. The more widespread use of air-conditioning systems, with their many ducts, gives us many added possibilities for the spread of fire, especially when such systems are installed in older structures. The passage of fire through air-conditioning, ventilating, and air-heating systems can be controlled by the use of fire-resistant materials in the duct work and by the installation of automatic controls which close openings, shut off fans and blowers, and set off fire alarms and the sprinkler system, if provided.

In remodeling existing structures of frame construction, or when placing new partitions in fire-resistant structures, the value to be gained from the use of fire-resistant materials should not be overlooked. These may vary from the use of wood which has been subjected to fire-resistant treatment to certain asbestos and asbestos-cement products. Some of the asbestos-cement products suitable for sheeting, wall panels and partitions not only give a high degree of fire safety, but are economical in other ways.

For those who may wish to pursue the subject of fire-safety in more detail, the following references are given:

National Board of Fire Underwriters
- Building Code

Central Station Protective Signaling Systems

National Fire Protection Association
- Handbook of Fire Protection
- Nat'l. Fire Code for Building Contruction and Equipment
- Employee Organizations for Fire Safety
- Building Exits Code

Protection Against Accidents

In new building construction, pre-planning in design and layout of the proposed structure has long been recognized as a necessity to secure efficiency in its intended function. Pre-planning for the safety of the employees occupying the building has, perhaps, in the past, not been given the recognition it deserves. However, we have now come to realize that accident prevention is a part of efficiency, and, if disregarded, prevents us from reaching our intended goal.

Many Factors Are To Be Taken Into Consideration in Designing a Building to Insure the Comfort and Safety of Employees

In this report, we shall discuss the practical things that may be done to overcome past shortcomings, and changes in the function of existing structures, rather than new construction.

Safe access to all parts of a building should be provided, regardless of the frequency with which they are visited. It is all too common to find in the isolated attic, the back corner of the basement, or around boilers, etc., where maintenance forces must go, makeshift ladders and steps that are tolerated because the thought is "no one ever goes there," or "only one man uses that."

Stairways

Stairways are much to be preferred in place of fixed or portable ladders and should be constructed to definite standards as to slope and width, considering their purpose. Main stairways, or those used for general ingress and egress, should be conveniently located to the working areas and should not be obstructed at top or bottom. They should, if possible, be alike in width of tread and in height of riser. Stairways for general use should slope between 30 and 35 deg. from the horizontal, and should never, under any circumstances, be under 20 deg. or over 50 deg.

It is recommended that no stairway for general use be less than 44 in. in width. Stairways for special purposes, used by a limited number of persons, may, of course, be narrower. Stairways having four or more risers should be equipped with hand rails, and the American Standard Code requires the following:

- Width less than 44 in., sides enclosed—one hand rail on right side descending.
- Width less than 44 in., one side open—one stair railing on open side.
- Width less than 44 in., both sides open—one stair railing on each open side.
- Width over 44 in., and less than 88 in.—one hand rail on each enclosed side and one stair rail on each open side.
- Width 88 in. or more—one hand rail on each enclosed side and one stair rail on each open side, and one hand rail down the center.

When the stringers do not provide protection, toe boards should be placed extending at least 3 in. above the nosing and open landings should also be so protected. Stair railings should be 40 in. in height and hand rails between 30 and 34 in.

The hazard of worn, uneven steps should not be overlooked. Wooden stairways are sometimes found worn to the extent that the nail heads are exposed sufficiently to cause a slipping hazard. Simply setting the nails will considerably reduce the hazard until more proper repairs can be made.

When stairs become slippery due to the action of traffic on the material of which they are constructed, the hazard may be overcome by the application of various kinds of anti-slip materials. Some of these are painted or troweled on, and others are similar to emery cloth and are glued in place.

A not uncommon hazard, particularly in the case of women with high-heel shoes, is the additional steel nosing and partial tread to be found in some older buildings. This may be alleviated by filling in behind the metal, which is generally about ⅛ in. thick, with linoleum or other suitable material.

It is realized that the remodeling of stairways in existing structures can be a costly job, but the possibilities in such work should not be overlooked when other remodeling or repair work is being done. However, a large measure of safety may be had by seeing that proper hand rails are provided, that no slipping hazard is present, and that proper lighting is afforded. All of these things can generally be corrected at nominal cost.

Floors

Worn or slippery floors can be a prolific source of accident. Wood floors that are uneven or tend to splinter may be re-

surfaced with one of several different products on the market. Most of these products are an asphaltic emulsion with some type of binder, and can be troweled to the thickness desired. If the proper type is used it will stand hard industrial usage. Another method that has proved satisfactory in offices is to install plyboard and a suitable cover, such as linoleum or asphalt tile.

For floors in small areas that tend to become slippery due to the process being carried on, the type of anti-slip material that is glued on has proved satisfactory. Where oily or greasy conditions are caused in a small area, one of several blotting materials may be spread on the floor to absorb the material during the work period and then swept up.

In the installation of concrete floors, particular attention should be paid to the finishing, so that undesirable conditions are not obtained. In one type of anti-slip concrete floor the desired quality is built in by allowing the expanded metal reinforcement to be exposed at the surface. This "Cloisonne" work has excellent anti-slip qualities.

Use of Color

Where built-in safety is lacking, a surprising amount may be provided with nothing more than the old paint bucket, plus imagination, and the use of data available as the result of studies made in the field of color. These studies have to do with the effect of color on lighting and its psychological effect on people.

The desirability of painting danger areas or signs in red, and impaired clearances with black or yellow and white stripes, to draw attention to them, is well understood. Also, the painting of passageways throughout a shop area, with some distinctive color to guide traffic and keep such areas free of stumbling hazards, is quite widely accepted. Not so well understood is the use of color to create a harmonious state of mind in the shop or office worker, as well as to improve seeing conditions.

This new color science may be likened to the opposite of camouflage. An all too familiar sight is the shop building with walls painted grey, and sometimes black to hide the dirt, and all machinery painted dark grey or other similar shade. This sameness of color can be as tiresome and boring as any other type of repetition, resulting in a surprising amount of indifference on the part of the employee, as well as reducing his seeing ability. We know that indifference and poor seeing conditions breed accidents.

In removing this old-time camouflage and light-blotting color scheme, we might start by painting the ceiling such a color as sky blue, to increase lighting efficiency and make it appear higher; walls a light green, to "push them out" and produce a harmonious contrast; the bodies of machines a light grey or green, and their tools, or working areas, light buff, to produce contrast with the material being worked and the bodies of the machines. Controls might be painted the same color as the tool area, and those items to which we wish to bring particular attention, bright orange.

In a large railroad machine shop where the latest theory in the use of color was worked out and applied, the first winter saw absenteeism drop 50 per cent, material spoilage practically eliminated, and accidents reduced to the vanishing point. Practically all the large paint manufacturers have made a study of these color phenomena and will work closely with anyone wishing to take advantage of their benefits.

Illumination

In the interest of safety and efficiency, adequate lighting is a "must." The amount of general lighting or supplemental individual lighting required for various operations is a problem for special study by the illumination engineer.

The problem of illumination and its psycological effect have to do not only with inadequate quantities of light, but with poor quality of light, such as glare. Light poor in quantity or quality results in fatigue, which directly affects the accident rate. Accidents also occur when people cannot see what they or others are doing, or cannot quickly detect moving objects or equipment or other hazards.

If we have a general knowledge of lighting requirements and accepted standards, many obvious cases of poor lighting may be corrected without the assistance of the illumination engineer. Some very general requirements follow:

For natural general lighting, if only one wall contains windows, the width of the room should be less than twice the height of the top of the windows from the floor. If windows are in two parallel walls, the width of the room should not exceed six times this window height. In general, single-story industrial buildings should have a window area of at least 30 per cent of the floor area.

To maintain good seeing conditions, some form of artificial lighting is required in any work area. Such lighting should give equal illumination over the entire work area so that changes that might be made in functional requirements will not require expensive changes in lighting.

The amount of general lighting required should be at least 10 per cent, and preferably 20 per cent of any supplemental lighting necessary for specific tasks, as the general lighting should not only provide for general seeing, but for keeping the brightness contrast between the supplementally lighted work and the surroundings within a degree which is comfortable to the eyes.

For further study of this important subject the following references are given:

Eye Hazards in Industry—Louis Resnide.

Recommended Practice of Industrial Lighting—ASA. Standard A-1101942.

The reports of surveys and studies made in various industries by the Illumination Engineering Society, 51 Madison Avenue, New York.

Remodeling—Electrical Hazards

When an existing structure is remodeled or its function changed, its load capacity should be checked. Structural failures have occurred when additional or new types of machinery have been placed, or new types of handling equipment, such as fork lift trucks, have been put into use in older buildings. One case is known where a lift truck put to use in a warehouse went through the floor with resulting serious injury to the operator.

A not uncommon hazard to building occupants is the misuse of electrical equipment. Even though the general wiring and other installations meet Code requirements, there are still hazards that may be set up.

Some of the more common hazards are the replacing of fuses with pennies or other metal objects, the overloading of circuits by unauthorized installations, the use of extension cords when permanent wiring should be installed, the failure to ground portable hand tools, and inadequate guarding of exposed conductors.

For safety and efficiency the location of electrical equipment should be carefully planned. Control boards, switches and other apparatus should be installed so that the possibility of accidental contact with them is reduced to the minimum, and, when necessary, they should be protected by special guarding. No electrical installations should be allowed to be made except by a qualified electrician, and frequent inspection by such qualified persons is a "must."

Replacing the old style fuses with circuit breakers will eliminate the possibility of tampering with this all-important feature. The importance of adequately grounding all electrical hand tools or other portable appliances, as well as the exposed metal parts of fixed equipment, should not be overlooked.

It is generally recommended that all portable appliances operating at 90 volts or more to ground be grounded. In any case, the National Electrical Code and any state or municipal codes should be followed.

Other Considerations

While not generally considered from an accident prevention standpoint, adequate sanitary facilities can mean a great deal in maintaining the health and morale of employees. Given the opportunity for personal hygiene, the employee's sense of well-being and self-respect will be fostered, as well as protection against industrial and communicable diseases. Sanitary facilities should include not only toilet and washing facilities but an adequate pure drinking water supply, locker rooms and, in some cases, showers.

In all buildings where high-pressure steam lines are installed for heating or other purposes a shut-off valve should be installed in the steam supply line in an accessible location immediately outside of the building. This is so that, in the event of an emergency, the steam supply can be quickly shut off.

The scope and limits of this report will not permit a discussion of the all-important matter of the storage and handling of inflammable materials, such as gasoline, turpentine, etc., in buildings. However, your

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committee earnestly suggests that members of the association inform themselves on this subject and, if in need of help, they contact proper authorities, such as municipal fire departments, the National Board of Fire Underwriters or the National Fire Protection Association, for specific information relative to the problem at hand.

In spite of all we might do to provide built-in safety in any structure, the largest part of accident prevention depends on eliminating so-called unsafe practices, and our best weapon in this respect is an educational program designed to teach safe working habits, to make our employees safety-minded, and to build up morale.

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Unfilled Needs in Power Machines and Power Tools for Bridge and Building Work

Report of Committee

FROM his very beginning on this earth mankind has endeavored to lighten and make easy his toil by providing mechanical means of doing it. At first, for countless ages, applications were simple and improvements were of slow development, dictated solely to making the burden of work easier. As time rolled on the tempo of man's existence stepped up, with improvements coming over night, based not entirely on humanitarian needs, but on economic considerations as well; witness the necessity of accomplishing definite tasks in the face of a dwindling labor supply during the war just past, and now in the face of diminishing financial returns.

Disregarding economic conditions, which even in our day has forced the curtailment of mechanized operations so that more hand labor could be employed, as occurred during the depression years of 1932 and 1933, let us give expression to what practical bridge and building supervisors wish for to lighten, improve and bring about greater economies in their work.

Treated timbers and piling in many bridges and buildings are now of such age that they must be tested for soundness. Prodding suspected timber with a steel bar is out of the question, and means for quick and accurate testing should be developed. It is reported that a device has been originated by a member of the engineering staff of a western state college, in conjunction with a western power company, whereby a repairman, by turning a crank, screws a probe into a treated pole. The resistance encountered is measured, indicating the soundness of the pole.

Transportation—Communications

Getting men to and from the job by means of track cars is proving expensive to the railroads, tiresome and irksome to the men, and a potential source for accidents. In well-settled sections of the country, paved highways parallel and intersect our various railway lines, so that buses or trucks, capable of being driven over the reasonably rough ground met with on rights of way for short distances, can be developed from equipment now available on the market.

R. W. Johnson
Chairman

In large bridge jobs, especially where considerable height or length is involved, a loud-speaker system would be of vast benefit, so that the foreman in charge could speak to any of his men, including the crane operators, regardless of where they are located. This would keep all on the job informed as to what was going on and would prove a tremendous factor in promoting increased safety.

Similar results could be obtained on a quieter scale by an electronic system of communication, in which all stations on a circuit could talk to or listen in on one another by means of a combination transmitting and receiving unit with speaker and microphone.

Application of a communicating or warning system to motor cars, whereby the occupants of such cars could be made aware of approaching trains, would be a long step ahead in promoting safety.

Off-track pile drivers, mounted on wheels with rubber tires or on caterpillar treads, are proving far more versatile and economical than the standard track drivers. There is the possibility of equipping these drivers with augers so they can be used to bore holes for setting in the piles. Also, if equipped with generators, they could operate a light-weight chain saw to cut the piling at the proper cut-offs.

*Deceased.

Light Bridge Derricks

Various railroads and some commercial firms have pioneered in developing a small derrick, mounted on a push car, for the handling of heavy timbers and castings. These usually have a table operating in a full circle and are counterweighted. They are hand operated both for raising and lowering, as the load, for considerations of safety, must be under control at all times. With the addition of a small geared motor, with power furnished by a small electric generator set of the type that is standard equipment for bridge crews, the work would be speeded up and manual labor lightened.

General-Purpose Equipment

Equipment mounted on rubber tires or caterpillar treads, depending on the terrain over which it is to be used, can consist of a compressor with the front end equipped with a light boom (this to be of a collapsible type for quick lengthening and shortening), a lifter for carrying timber and placing it where desired, a boom and bucket for excavation, a bulldozer blade, a winch, and even a mower. This type of equipment could erect and finish small steel spans, completely erect pile and timber bridges, excavate for foundations, lay culvert pipe, and make the back-fill. Bulldozer equipment is invaluable in case of washouts.

Small Electric Tools

As most bridge and building crews are now equipped with electric generators, there seems to be a demand for electric-driven tools, such as a one-man hack saw for cutting drifts between piles and caps, and between stringers and caps; dies for cutting threads on bolts to fit the lengths required on the job; impact wrenches for tightening and removing nuts on ¾-in. and ⅞-in. bolts; and a riveting hammer for driving ¾-in. and ⅞-in. rivets.

Hydraulic jacks, because of their lightness and lifting power, are much preferred by bridge crews. Work with these jacks would be expedited considerably if a small high-pressure hose would be attached to them, leading from a small power-driven hydraulic pump that would raise the jacks at the same speed at which they are now lowered.

Girder carriages, with flanged wheels running on rails, are commonly used to roll in steel spans erected alongside structures to be replaced. When the new span or spans are in place, jacks must be placed to raise them in order to release the carriages, and then to lower them into place. Jacks built into or forming a part of the girder carriages could lower the loads into place as soon as they were correctly spotted.

Many Types of Bridge and Building Work Lend Themselves to the Use of Power Tools

A light-weight jack for pulling chord and line bolts is advocated by one supervisor who has developed a jack for pulling drifts, but who finds it too heavy for pulling chord bolts.

Water Supply

For pulling turbine pumps out of deep wells, hand-operated winches are still in use. With such winches the work is slow and a large crew is necessary, especially for very deep wells. The Milwaukee Road has built two types of pullers which have proved very satisfactory. One consists of a standard five-ton hoist made by a Seattle concern, with a very small cast-steel winch, weighing about 100 lb., mounted on the upper plate of a steel bracket. On a lower plate of the same bracket there is mounted a five-horsepower, three-phase, reversible, induction motor, connected to the hoist with three "V" belts. This bracket frame with hoist and motor can be handled by two men and, when in use, is attached to one of the posts of the tower. One man can raise or lower the well equipment by merely pushing a button. This piece of apparatus can be transported on a passenger train and can be set up very quickly. It has been used to pull a turbine pump, 6-in. column 2½-in. oil tube, and 1½-in. shaft with 400-ft. setting, by using four-sheave wire rope tackles.

A more improved type of puller has been built which consists of a heavy lift hoist, such as is used in machine shops, forge shops and foundries, which is driven by an enclosed motor operated on 220 or 440 volts, and equipped with a solenoid-type motor brake. The drum is grooved for the steel hoisting cable. This completely self-contained unit, with switch box, is mounted on a body on four steel wheels (these should have been rubber tired). It is pulled up outside the pump house and is ready to work when the necessary blocks are rigged up.

Portable equipment for cutting large size pipe, 6 in. in diameter and greater, and also for threading it in the field, is desirable.

Welding—Riveting

Field welding will be much more satisfactory and will be more extensively employed if it can be tested with the same facility and accuracy obtainable under shop conditions. Adoption of shop equipment and technique to meet field conditions would be of the utmost of value.

For cover-plate work, a light yoke riveter, mounted on a frame so it can be moved along a stringer, floorbeam or girder, will drive more rivets with far better results as to filling the holes, and as to appearance, than is possible with regular pneumatic hammers.

A self-plugging rivet, comparable in shear strength to a solid rivet, has been developed to be driven where only one side of the structure is available to the riveter. This consists of a hollow rivet, and a stem with an oversize end. With the oversize end pushed through the rivet, the rivet is stuck through the rivet hole from the front side. The pulling head of a special gun engages the rivet stem which, as it is pulled through the hollow rivet, expands the shank of the rivet. When the oversize end of the stem is pulled entirely into the rivet, it is cut off at a notch. The broken section of the stem is ejected from the gun, and the stem left in the rivet is trimmed flush with the rivet head. These rivets are now available in sizes not larger than 9/32 in. in diameter. They would have to be increased to ¾ in. and ⅞ in. in order to be suitable for use in steel railroad structures.

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Paradoxical as it may seem, the elimination of riveting entirely may be in the offing. There is a feeling among bolt manufactures that a bolted joint can be developed as strong as a riveted joint. If such is developed, a lot of time and money will be saved putting in bolts and then taking them out again, as the bolts put in for erection can stay in. However, impact wrenches used to tighten the nuts should be designed to upset the bolt threads so the nuts cannot work off.

Lightweight Tools

Without question the weight of tools and equipment should be reduced as far as possible by the use of the various light metals, such as aluminum and magnesium. For instance, a prominent chemical company is planning to manufacture a wheelbarrow that will weigh 30 lb., or 55 lb. less than the type commonly used. This will be accomplished by making the body of magnesium instead of steel, and the frame of tubular steel. To make operation of the wheelbarrow still easier, it will have anti-friction bearings and a pneumatic tire.

This reduction in weight can be applied to a large number of hand tools, where weight is not essential in their use.

The use of timber for staging, needle-beams and scaffolding could be eliminated by employing light metal platforms, trussed if necessary for greater rigidity. Scaffold fastenings of rope are cumbersome to handle and are subject to damage by cutting and by sparks from cutting torches. These should be replaced with light steel chains with special hooks at one end for quickly adjusting the staging to the right height, and with special attachments at the other end so they can be readily secured to the flanges of steel bridge members, timber stringers, rail, etc.

In conclusion, your committee finds that the manual effort involved in doing work must be lightened to attract workmen to the railroad, and that all work must be done as economically as possible, if the railroads are to survive.

Recently, your chairman saw a farmer loading a pile of scrap bridge ties on a wagon, using a front-end lifter on his tractor. Yet your chairman knows that bridge men had handled each of these ties

individually several times when new—off the freight car, onto piles, onto push cars, off of push cars, and into the deck. Then, when worn out, they were handled out of the deck, onto a push car, and then onto a pile. It seems evident to this committee that there is much room for further improvement in power machines and power tools, and need for their wider application in bridge and building work.

Committee Personnel

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Discussion

Several members commented on the timely aspects of the problems considered in the report when viewed in the light of increased costs of materials and particularly the recent wage increase granted to maintenance employees. Lee Mayfield (M.P.) told of the development of a new gasoline-driven chain saw for cutting off piles. F. M. Misch (S.P.) described a recent development made by a bridge foreman on his road, who combined a push-car derrick with an air compressor and an air motor to produce an air-operated derrick which has performed very satisfactorily.

Inspection of Substructures and Underwater Foundations

Report of Committee

THE oldest structures in the world are of masonry. There is probably nothing more substantial than a properly designed and constructed concrete or stone substructure. Some such structures need very little inspection under normal conditions. However, all railroads are rightly concerned about the safety of bridge substructures during floods.

Severe floods may not be frequent. Sometimes they occur at frequencies greater than a lifetime. It is entirely possible, therefore, that the men responsible for the safety of substructures during a flood may never have experienced a similar emergency, even though they have been inspecting and maintaining bridges for many years. It is the aim of this report to relate the experiences of men who have been responsible for the safety of substructures during floods, so that those with less experience may profit thereby.

L. D. Garis
Chairman

Rainfall and Flood Frequency

Annual rainfall in the United States varies from 10 in. to 100 in., but regardless of this variation, there are five recognized generalities.

(1) Intense storms usually cover only small areas and are of short duration. Rainfalls of 1 in. to 2½ in. in 10 to 15 min. over small areas have been recorded at nearly all weather stations. These are sometimes called flash floods.

(2) Storms lasting several days cover large areas and fall at low intensity.

(3) The magnitude and intensity of any storm bears a direct relationship to its average frequency of recurrence.

(4) There appears to be no close relationship between the total annual rainfall at a given locality and the number or magnitude of intense storms likely to occur in a given time period.

(5) The total annual rainfall gives a good indication of total volume of run-off, most of which occurs at less than critical rates.

We feel justified in giving some consideration to measures taken to prevent wash-out accidents. One of the problems that confronts us today is how to prevent a train running at 100 m.p.h. from entering territory where bridges or track have been washed out or made unsafe by a flash flood, with water traveling at 20 to 30 m.p.h. This calls for teamwork and quick decisions by both the operating and engineering departments.

Spotting Floods

All railroad employees should be on the alert to get all available information concerning severe storms. In the engineering department the chief storm spotter is the section foreman. All books of rules make it his responsibility to report storms and to patrol track. With present-day long sections this is a difficult assignment. Section foremen should be encouraged to use local telephones to keep informed concerning rainfall, and all section foremen should know all methods and routes to reach dispatchers by wire. The record of these 24-hour-a-day guardians of safe track is very good and they are entitled to our encouragement.

It is possible to obtain reports from points off the railroad and several railroads report that they have established contacts for rainfall and storm information from state highway departments, government lock tenders, other railroads, and direct from weather bureau offices. Forecasting storms is one of the most legitimate functions of the government, and it is the duty of railroad officers to keep the channel for this information open, even for the storm which comes but once in a lifetime.

Rules and Instructions

Several books of rules were examined and a questionnaire was sent out to determine precautions taken by railroads during floods. In our questionnaire we asked, "Are trains ever operated on your railroad under instructions to enginemen, 'Look out for high water conditions'?" The answers showed it is a common practice. One railroad produced a book of special instructions issued to all operating employees, such as superintendents, dispatchers, and trainmasters, as well as to master carpenters, bridge foremen, roadmasters, track foremen, track supervisors, bridge and building supervisors, etc., which contains a rule reading as follows:

"Trains must not be operated under instructions to enginemen to, 'lookout for high water conditions,' nor should train and enginemen be told to determine whether it is safe to use a bridge which may have sustained damage by reason of high water. These employees do not have equipment or tools to ascertain such conditions and generally their experience and training are such that they do not have the knowledge to evaluate accurately the information that they might obtain."

There are still in force on many railroads rules which, while a little ambiguous, seem to designate conductors and enginemen as competent bridge inspectors. One such rule, sometimes called the "between stations" rule, is as follows:

"When overtaken between stations by a severe storm or indications of high water which threaten damage, trains will proceed at restricted speed. Conductors and enginemen will examine bridges and culverts or other places subject to damage by high water and if they find any indication of

danger will, on arrival at the first point of communication, notify the agent or operator, report by wire to the chief train dispatcher, and not proceed until instructions are received."

Where this rule is still in effect it should be interpreted to mean stopping the train and getting to the nearest telephone to make report. We feel sure that the men who operate trains prefer to have the engineering department examine bridges and culverts. This rule is being changed in the more up-to-date books.

In our questionnaire we also asked, "Who is authorized to permit trains to proceed across bridges where water is over the ties?" It was considered that this is a definite condition which can be immediately recognized by enginemen and conductors, and that the practice followed on different railroads would be interesting. One small railroad indicated that this was the responsibility of the engineer of maintenance. Most larger railroads named division officers, such as supervisors of bridges and buildings, roadmasters, or division engineers.

Some railroads have time card rules similar to the following:

"Streamliner-type trains and gas or Diesel-electric motor trains and engines must not be run over inundated track if water is more than five inches above top of rail, and when operating through water speed must not exceed 6 m.p.h."

Where such rules are in effect, all concerned should know that they prohibit operation, even though track and bridges are safe, and that under such conditions trains should be permitted to proceed only on signal from a flagman authorized to act for a representative of the engineering department.

Operating department men and those in the engineering department all know that trains can not and should not be stopped for ordinary rain storms. When to hold trains must always be a question of judgment, but it is well to have some generally recognized authority on which to base such judgment. We quote at length from instructions issued by a large western railroad, which we have selected for this purpose.

"General—If a sectionman, bridgeman, operator, other station employees, trainman, engineman, dispatcher, or any other employee, supervisor or officer, has reason to think a condition exists or threatens which casts a doubt as to safe train movement, his first obligation is to take appropriate action to stop trains immediately; and his second obligation is to assist, according to his position and the circumstances, in determining the actual conditions.

"Handling Trains During Flood Conditions—When there is doubt, the most important thing is, first, to stop and find out whether it is safe to proceed, rather than to keep moving until it is known to be unsafe to continue. There is a vast difference between these two courses, and a clear conception of that difference is the greatest single principle to keep in mind.

"If in an abundance of caution trains are stopped when subsequent investigation reveals that such was unnecessary, there will be no criticism. Obviously, if trains are stopped each time they should be under these instruction they will occasionally be stopped needlessly.

"Whenever trains are stopped pending inspection and determination of actual conditions, they must not be released until the conditions ahead are known, beyond a possibility of doubt, to be safe at the specified speed. Trains must not be so released when there is any possibility of danger either by cutting or scouring action of water, or by bridges, etc., floating down the stream.

"At times, trains may be released by having maintenance of way employees on motor cars precede them. Whenever this is done the train must move at 'restricted speed' and there must be a clear understanding between the men on motor car and the train and enginemen concerning the signals or other information to be given by, or received from, the men on the motor car.

"In other instances, watchmen should be stationed at proper locations where they may stop or otherwise control the movement of trains. Whenever this is done the speed of a train approaching the location of the watchman should be at 'restricted speed', and there should be definite understanding with train and enginemen concerning the advice to be obtained from the watchman and the manner in which that advice is to be furnished. When conditions warrant, trains must be stopped, and proceed thereafter only as authorized.

"Particular care must be exercised in some locations to guard against difficulties during ice gorges, or when ice is breaking up and moving freely."

Inundated Track

We attempted to secure through our questionnaire information that would help an engineer to know under what conditions it is safe to operate over inundated track or damaged bridges while the water is still high. It seems as though this usually calls for getting all the information available by wading, sounding, and probing with the best obtainable tools. This information is then checked against plans and office records, using telephones and telegrams where necessary. There is nearly always a conference between the engineer and the more practical men, such as section foremen, bridge carpenters and supervisors of bridges and buildings, who are apt to have more knowledge concerning previous floods and local conditions. After such considerations, trains can often be moved over inundated track with safety and without great delay. Cases were reported where loaded cars were placed on flooded track, both to hold it down and to test it.

It is important that after any unusual high water a more careful and complete inspection of all substructures should be made than could be undertaken before the flood subsides. During such an inspection the expansion of steel spans should be carefully noted and compared with previous records. Unusual expansion is very likely to indicate a tipping or movement of an abutment or pier. The height from base of rail to the lowest point in the waterway should also be measured and compared with the distance from base of rail to bottom of footing, as shown on the plans. In this connection, it is important to note the record of piles as shown on the plans or in other records. If there is a question concerning the existence of piles, it will be well to do some excavating to settle the question. The judicious use of a shovel has been known to reveal very interesting and surprising facts. One of the members of our committee, the engineer of bridges on a midwestern railroad, reports as follows:

"It was a rather interesting experience years ago to be sent out to inspect an abutment on the Wabash river, at Logansport, Ind., that was reported as riding rough. The water was low and away from

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In Attendance from the Southern Pacific Were: (Left to Right) S. L. Chapin, Supt. Safety, San Francisco, Cal.; H. J. Pennington, Gen. Trk. Supvr., San Francisco, Cal.; F. M. Misch, Gen. B. & B. Supvr., San Francisco, Cal.; A. T. Stackhouse, Rdm., Colfax, Cal.; and N. R. Robinson, B. & B. Supvr., Sacramento, Cal.

the abutment. The abutment was high and there was a vertical crack the full height at about the junction with the 30-deg. wings. I felt sure the abutment had settled a little due to excess toe pressure and started to leave the site with such a report in mind. However, seeing a house not too far away, I went over and borrowed a shovel. I had to dig down only about 2 ft. to get to the bottom of the footing and found that I could not only push the full length of the shovel under the abutment, but could even turn the blade around.

"During a previous very high water, the high fill had washed out back of this abutment for a considerable distance. A temporary trestle had been built and new fill placed before the water had entirely receded. This abutment had undermined from the back side, which is possible, but to me is still unusual. By carrying this abutment six feet deeper, it would have had a solid rock foundation. However, in those days, they didn't pay too much attention to foundation depth. We dug down to the bottom of the abutment, rammed in sand and gravel by hand as tightly as possible, then solidified this by grouting."

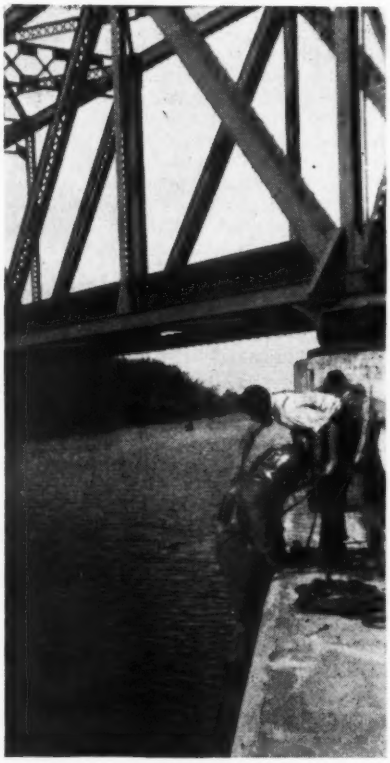
A large eastern road gave us an account of a very systematic method of taking soundings and keeping records. For all river bridges where there is any active erosion, this railroad has layout plans of abutments and piers, with points indicated at which depth from bridge seat to streambed are to be measured. These points are marked by circled numbers. The inspector is furnished with a boat and with pipes for taking soundings in deep water.

The plan is marked up each year and gives an excellent case history of the erosion that takes place. Substructures resting on rock are not kept off this list, and a case was sighted where these yearly soundings showed erosion taking place under piers resting on natural rock. The bridge inspector was able to do some probing under the footings and his findings were checked by a diver. The area around the piers was dewatered, and when mud and loose material were cleaned away it was found that the footings were sound but that parts of a leveling course had been eroded away. The piers were protected by a concrete encasement, completely around the piers, and carried down to bed rock.

All roads questioned indicated the infrequent use of divers to determine the underwater condition of foundations. In the case of the few structures where the water is deep and some combination of erosion, excessive vibration, settlement, age and inadequate design are known facts, a diver is sometimes used. His services usually cost about $100 a day, from the time he leaves his headquarters until he gets back, together with all travel expenses and pay for his assistants. A large eastern railroad reports using a diver having an outfit equipped with a telephone. This makes his work much more efficient as he does not have to come to the surface to report.

Regular Inspection

Regular inspection should always be started by knowing the year in which the structure was built. If it is of recent adequate design, a quick visual inspection of the exposed portion is all that is required. The only necessary record is a check mark, the date of the inspection, and inspector's initials.



Divers Are Sometimes Used to Make Underwater Inspections of Foundations When the Water Is Unusually Deep

When the date of stone construction is back in Civil War days, the inspection should be much more deliberate and in far greater detail. A pointed hammer or a timber inspection bar is used to sound stones that appear suspicious. A sketch is often made of arches or abutments to show the location and extent of disintegrated stones and cracks. All plans are carefully considered. Unless masonry structures of such age are unusually well preserved, consideration should be given to rebuilding them, or to subjecting them to major repair and strengthening operations. It is important to take care of the poorest of such structures first, and it is necessary to have as accurate a picture as possible of the condition of each of these old structures. Usually, the concurring opinion of more than one competent technical engineer is necessary to secure the consent of management to the expenditures necessary for rebuilding or major repair and strengthening work.

The rate of increase in the size of cracks is an important matter to consider. The record of cracks is best kept by placing two indicator boards edge to edge, with the ends of each anchored to the masonry on opposite sides of the crack. A saw mark is then made across the two boards and any increase in the size of the crack is at once indicated by the saw marks being out of line. There have been cases where there was great concern about cracks in stone and concrete substructures, but this concern disappeared when such indicator boards showed no development in these cracks over many years. One western road reports that these boards have indicated slow or no movement in most cases.

The defects that are found in stone masonry, mass concrete and cylinder pier substructures during routine inspections, and which are of interest, should be carefully described when the inspector intends to request authority for rebuilding, or where repairs are unusual or extensive. The following is from the Instruction for the Inspection of Bridges on a large railroad.

"*Stone Abutments and Piers*—General overloading of foundation, indicated by vertical settlement or pumping.

"Local overloading of foundation, indicated by sagging of the horizontal joints, open vertical cracks, and crowding of backwalls towards the span.

"Tilting of a part of or the entire substructure, indicated by shearing of anchor bolts, displacement of expansion rollers, and reduction of clearance at ends of spans.

"Horizontal movement, that is, sliding on foundations without tilting, indicated by changes in vertical or inclined surfaces, and the symptoms listed under 'Tilting'.

"Weakening of the foundation, caused by scouring or undermining.

"Whether soundings are necessary to determine what should be done.

"Failure of bond between stones, indicated by the looseness or the absence of mortar at joints; vertical cracks caused by uneven bearing; bulging of parts of surface, indicating internal failure.

"Overloading of individual stones, indicated by split or broken stones, usually directly under the bearings or in the course below the bearing stones.

"Disintegration at the water of ground line, caused by frost.

"Surface disintegration of stones, indicated by weathering, spalling, laminating or slicing, and breaking out of small parts.

"*Concrete Structures*—Whether weathering and disintegration result from improperly proportioned materials, indicated by a porous condition; poor placement methods, indicated by laitance spots or seams; stone pockets and surfaces spalling due to freezing or loss of surface water through the forms; seepage through concrete, indicated by crystalline efflorescence on the surface and by discoloration from chemical action. Surface absorption of moisture which corrodes the metal reinforcement also softens the aggregate and causes breaking up by alternate freezing and thawing.

"*Cylinder Piers*—Displacement of cylinder piers by ice pressure; horizontal movement of piers on natural rock and in shallow water; tilting of piers on piling and in deep water. Drainage from top of pier to prevent damage from water freezing between concrete and shell.

"*Arches*—Condition of stone in arch ring and parapet walls; settlement cracks in barrel; sliding of parapet walls on barrel of arch; movement of wings and ends of barrel; extent and location of leakage through barrel of arch."

Movements of Abutments

One of the most common defects of old masonry abutments where the ratio of height to base of footing is high is for

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them to tip in, showing this movement by sheared girder anchor bolts or excessive expansion on rollers, and finally by the backwalls coming in contact with the steel. Where this movement is slow, as 1 in. to 4 in. in 50 years, it can usually be tolerated until a more rapid rate of movement is noted or other defects become evident. Where tipping is the only consideration, repairs have been made by chipping out the backwalls to prevent damage to the steel.

Where it has become necessary to stop the tipping movement, one western road reports that pile bridge-approach spans have been built to take part of embankment load from the abutments. This road also reports placing steel struts betwen abutments where the span is short and the abutments are high. In other cases the abutments are anchored with rods passing through them to steel sheet piling driven in the embankment. Consideration is being given to bracing such abutments and backwalls with concrete buttresses. The necessity, economy and effectiveness of these various types of repairs might well furnish the subject for a future report.

Inspection Personnel

All railroads maintain some system of bridge inspection. There are, however, a great variety of titles for, and many different opinions concerning the qualifications of, an inspector. Our questionnaire revealed that one small railroad considers that a bridge carpenter with high school education, 5 to 10 years' experience, and a reliable character, is qualified to inspect structures and report defects. The engineer of bridges qualifies this, however, by stating that, "In case unusual conditions are found, any man who is not a competent designer would need immediate assistance from the bridge office to check and interpret his findings." On a small railroad this assistance might be quite immediate. On a larger railroad, however, the inspector might be 1500 mi. from the bridge office.

In contrast to this, the engineer of bridges of a large western line states, "The bridge engineer is also responsible for the inspection of all steel and concrete structures." This bridge engineer spends a considerable portion of his time on the line acting as an inspector and has no difficulty in obtaining immediate assistance from the bridge office to check and interpret his findings. It might be said that the bridge office is at the point of inspection. No doubt he can also secure readily the advice of practical men who have spent years building and repairing bridges.

On another large western railroad the engineer of bridges reports that division engineers and chief carpenters are responsible for inspection on their respective divisions. He states further that all division engineers are college graduates with considerable railroad experience. His chief carpenters are men who have had long experience with the railroad as bridge foremen or with some other responsible duties before taking over the job of chief carpenter.

All answers to our questionnaire indicate the frequency of inspections as at least twice a year. Usually one of these inspections is made with a qualified technical engineer as the head of the inspection crew. It is quite generally stated that more frequent inspections are made of some structures.

From the information collected, it is quite evident that two types of men contribute to any system of bridge inspection. One type is the competent technical engineer, usually a college graduate, with considerable railroad experience. These men, to an increasing degree, are receiving recognition by law as registered professional engineers. The other type is the chief carpenter, or supervisor of bridges and buildings, who has had years of experience in the actual building and repairing of bridge substructures. The fact that both types are trusted to inspect, and thus control the standard of maintenance and safety of, the railroad bridges of the country, with so little governmental control, is evidence that they are men whose judgment and reliability are generally recognized. They are also out-door men of courage who can make quick decisions, even to the point of stopping traffic. Their record is excellent, for bridge failures are not frequent. There are many of both types in this association.

Committee Personnel

Leo D. Garis (chairman), gen. br. insp., C. & N. W., Chicago; J. R. Burkey (vice-chairman), consult. engr., Union Metal Mfg. Co., Columbus, Ohio; J. R. Showalter (vice-chairman), br. engr., M. P., St. Louis, Mo.; J. S. Hancock, bldg. engr., D. T. & I., Dearborn, Mich.; H. A. Hunt, b. & b. supvr., T. & N. O., Houston, Tex.; J. A. Jorlett, mast. carp., Penna., Pittsburgh, Pa.; B. D. Keatts, Intrusion-Prepakt, Inc., Cleveland, Ohio; B. H. Sargent, Sargent and Boyd, Dearborn, Mich.; E. W. Scott, asst. div. engr., Erie, Buffalo, N. Y.; C. J. Shapland, asst. engr., C. V., St. Albans, Vt.; S. H. Shepley, asst. ch. engr., E. J. & E., Joliet, Ill., and C. U. Smith, consult. engr., Lindsay, Cal.

Officers and Directors of the American Railway Bridge and Building Association for 1947-48: (Left to Right) F. G. Campbell, Ch. Engr., E. J. & E., Joliet, Ill., Past President; G. E. Martin, Supt., Water Service, I. C., Chicago, Fourth Vice-President; W. A. Huckstep, Gen. Bldg. Supvr., M. P., St. Louis, Mo., Third Vice-President; W. F. Martens, Gen. Fore. B. & B., A.T. & S.F., San Bernardino, Cal., Second Vice-President; E. H. Barnhart, Div. Engr., B. & O., Garrett, Ind., First Vice-President; J. S. Hancock, Br. Engr., D.T. & I., Dearborn, Mich., President; C. R. Knowles Supt. Water Service (Retired), I. C., Chicago, Treasurer; W. D. Gibson, Asst. Engr., C.B. & Q., Chicago, Director; Lee Mayfield, Res. Engr., M. P., Houston, Tex., Director; L. R. Spofford, Asst. Div. Engr., B. & M., Dover, N.H., Director; F. M. Misch, Gen. B. & B. Supvr. S.P., San Francisco, Cal., Director; H. M. Harlow, Asst. Gen. Supvr. B. & B., C. & O., Richmond, Va., Director; and H. B. Christianson, Prin. Asst. Engr., C.M.St.P. & P., Chicago, Director

Discussion

Commenting on that part of the report dealing with the inspection of foundations during and after high-water, F. M. Misch (S.P.) outlined his road's method of permanently marking the lengths of piles, etc., so that the effect of scour can be determined quickly in the field. He said it was their standard practice to drive nails, in the form of numerals, into the outside pile of each bent, both on the upstream and downstream side to show the minimum penetration of piles below cut-off in that particular bent. On concrete bridge piers, figures are cast in the concrete to indicate the depth from the top of pier to the bottom of concrete. In the event that such piers are supported on foundation piles, numerals are cast in the concrete below the others to indicate the depth from the top of pier to the bottoms of the piles. Thus, 40 over 75 would mean that a 40-ft. pier rested on 35-ft. piles. He stated that this method had been very effective in determining the safety of bridge foundations during high water.

B. C. Phillips (C.B.& Q.) closed the discussion by saying that his road uses a system similar to that described by Mr. Misch, except that the nails are driven as Roman numerals instead of Arabic. He added that stainless steel numerals are fastened to the fenders to show the same information.

What's the ANSWER?

Removing Washout Cribbing

When a track has been cribbed to carry it over a washout, how far is one warranted in going in removing the cribbing as the opening is being filled?

Removal Is Impracticable

By E. C. VANDENBURGH
Chief Engineer, Chicago & North Western, Chicago

While it would be most desirable to remove all of the cribbing in repairing washouts, I have found it to be impracticable. Such repair work is nearly always carried out under pressure to restore the line to service at the earliest possible date, and the removal of cribbing is a time-consuming and expensive procedure.

If new timber has to be used for cribbing, it should be so placed as to be most readily removable. In such cases a crane or caterpillar tractor will save time and heavy hand labor.

In my own experience, I have eliminated the use of new timber for cribbing entirely, as I have found it to be possible, by prompt action, to assemble worn out material as fast as it can be utilized. No effort is made to remove such material, except such sticks as may be readily accessible.

In further explanation, I might say that as little cribbing as possible is used, the cut banks at the ends of the washout being sloped down for the track which is cribbed just high enough to permit the movement and dumping of cars of filling material. Any further track raise that is required is brought up on filling material by the use of jacks, thus leaving the cribbing in the lower fill.

I think the need for removing cribbing is exaggerated unless track is cribbed up close to the final grade. I have found old cribbing in washouts which had been put in 25 to 30 years before, which was still sound, and in fact have on many occasions re-used such material. It is my opinion that there is no adverse effect on the track by leaving cribbing in an embankment where an ample cushion of embankment and ballast is provided above it. The cribbing does not decay and no further settlement of the embankment is experienced after the filling material has settled in firmly.

Only Remove If Near Grade

By DIVISION ENGINEER

The disruption of train service that is caused by washouts requires that tracks be repaired and schedules restored as quickly as possible. It is acknowledged that such repairs are made for speedy restoration of service, not for permanence, nor for economical future maintenance.

In the course of making these repairs cribbing may be used as a temporary support for the track. It is temporary not in the sense that it will or should be removed later, but rather because it is not the final track support.

Necessity seldom requires that cribbing be raised to the height of the final grade. Should it be necessary to support the track on cribbing at grade until after service is restored, that cribbing, or a portion of it at least, should be subsequently removed. Unless it is, the track will always ride unevenly and have too little resilience.

Whenever cribbing is used merely to support the track while filling material is being "dragged" to fill the opening, the track can be raised on ballast to the final grade by as many lifts as required and the cribbing buried. The track will settle as the filling material is vibrated around the cribbing and until all voids are filled. More than ordinary maintenance will be required for quite a while, but when settlement finally stops, the quality of line and surface will give no indica-

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Send your answers to any of the questions to the What's the Answer Editor. He will welcome also any questions you wish to have discussed.

To Be Answered In the January Issue

1. *Where soft spots or sinks in track require frequent surfacing, should they be tamped level with or above the adjacent stable track. Explain.*

2. *To what extent is it practicable or desirable to air condition passenger stations or special areas within such stations? Are there special problems involved?*

3. *To what extent can grouting be used to stabilize sidehill or embankment slides? What special considerations or methods are involved?*

4. *Should photographs be taken of bridge or bridge details during inspections? If so, what are the advantages of this practice?*

5. *Should the track be dressed as heavy maintenance operations progress during the working season, or should this work be delayed until the late fall or winter months? What are the advantages or disadvantages of each practice?*

6. *What is meant by the term "hungry water"? What are the effects of using such water in steam or Diesel locomotives? Does it require further treatment?*

7. *Under what conditions is it practicable to use reflectorized switch targets or indicators at main track switches? What are their advantages and disadvantages?*

8. *What are the newer types of glass available for windows and skylights? To what extent are these adaptable to various types of railway buildings? Have they special advantages?*

tion that any cribbing is buried in the embankment.

My experience several years ago at a washout which required that the track be cribbed is a case in point. That cribbing was never removed and after several months of intensive surfacing, the track was restored to its scheduled high speed. During the next several years there were many times when I clocked a passenger train over this piece of track at more than 100 m.p.h. while riding comfortably. I doubt if the stability of that track will show any material change 20 years from now.

Significance of pH Numbers

What is meant by the pH factor in water analysis? What particular significance does this factor have in connection with the treatment of water for cooling and heating purposes on Diesel locomotives?

Pure Water Has pH of 7

By Walter Leaf
Research Technician, Denver & Rio Grande Western, Denver, Colo.

Before discussing the subject it is advisable to explain what pH numbers represent. In absolutely pure water, which is a rarity, H_2O is ionized to H^+ ions and $(OH)^-$ ions. Naturally, there are the same number of each, and the degree of dissociation or ionization is extremely small. It has been found by experimental work that the concentration of either hydrogen or hydroxyl ions in pure water is equal to 1×10^{-7} or 0.0000001 gram moles per liter of water, and consequently the product of hydrogen ion times hydroxyl ion is equal to 1×10^{-14}. In certain phases of chemistry, pressure and concentration are equivalent terms, hence the p in pH means pressure or concentration of hydrogen ions, and H specifies hydrogen ion.

In all water solutions, regardless of what the dissolved material is, there are hydrogen and hydroxyl ions, and the product of the concentration of each, expressed in gram moles per liter is always equal to 1×10^{-14}, so that even in a strong caustic soda solution, hydrogen ions are to be found.

The numerical values used to express pH are the exponents of 10, without the minus sign, which indicates the ion concentration. Thus chemically pure water has a pH value of 7. Acid solutions have pH values below 7 but they can never equal zero. Basic solutions have pH numbers above seven, which can never quite reach a value of 14.

We could just as well express hydroxyl ion concentration by the term pOH, and for pure water the value would be 7. In a solution where the pH value is 4.5 the pOH value would be 9.5. A pH of 5 indicates 10 times the hydrogen in concentration expressed by pH 6.

Various complex organic compounds have the property of changing their composition slightly and reversably as the pH of their solutions in water is changed, and with a change in composition there is a change in color. Consequently certain organic compounds can be used to indicate the pH value of water solutions, and are termed pH indicators. The basic method of pH measurement is the determination of the voltage of a hydrogen electrode in the solution. Other electrodes can be calibrated to indicate pH and there are various electrical apparatus on the market for that purpose. Whether electrical apparatus or indicators are used depends upon availability, type of water to be tested, etc.

In investigating the corrosion of various metals under a wide variety of conditions it has been found that the pH value of a solution in contact with the metals may have a bearing on the rate of corrosion. Thus, iron dissolves in hydrochloric acid solution with a low pH value. Also it has been found that a solution with a pH value above 7 is not as corrosive to ferrous metals in general, as one with a lower value. However, pH value alone is no indication of the corroding power of a solution of ferrous metals. In natural waters such dissolved solids as magnesium or sodium chloride may cause serious corrosion even at pH of 9.5. Sodium silicate in sufficient concentration may give excellent protection to iron at a pH as low as 5. So the author has always maintained the attitude that pH alone is rather meaningless in corrosion studies. There are so many other factors which may "upset the apple cart."

In Diesel cooling water treatment it has been found in the Rio Grande laboratory that certain proprietary compounds based on chromates are the best protectors. It has also been found that adding sodium silicate, hydroxide, or phosphate to the chromate material increases its efficiency. All of these three sodium compounds increase the pH value but their efficiency in reducing corrosion is not due to this pH increase alone.

Chromates as a class have long been used in corrosion control. A recent theory is that the surfaces are polarized by oxygen gas in certain cases, displacing the previous theory that a dense metallic oxide film gave the protection. Thus, where the velocity of water flow was sufficient to remove this oxygen film, corrosion continued, and was termed cavitation.

The oxygen gas film in a number of cases will adequately polarize dissimilar metals in electrical contact so that no electrolytic corrosion will take place. Merely wiping the metal surfaces lightly with a finger will remove the film, and if there was nothing to replace it, corrosion would proceed.

In cathodic protection, the surfaces are polarized by hydrogen gas, thus giving protection. In this case, the pH near the protected surface may be far below 7, yet corrosion is stopped.

Where aluminum or zinc is exposed to the cooling water, a high pH may cause rapid corrosion, since both of these metals are soluble in caustic solutions, forming aluminates or zincates. In the case of aluminum, chromate treatment may give fair protection, but this is probably not true with zinc. However, chromate treatment seems to protect brass against dezincification of high pH values. Because of these varying conditions, pH values, of themselves, are absolutely meaningless in water treatment for Diesel cooling systems.

Denotes Degree of Acidity

By T. A. Tennyson, Jr.
Chief Chemist, St. Louis Southwestern, Mt. Pleasant, Tex.

The pH scale is used in water analysis to measure the "degree" of acidity or alkalinity of a water solution. This refers to what is sometimes called the strength of the acid or base (alkali) and not necessarily to the quantity present, which is determined by the titration method. Pure neutral water (or an exactly neutral solution) has a pH of 7.0 at the standard reference temperature. A pH value of less than 7.0 indicates that the solution is acid, while a pH value of more than 7.0 indicates that the solution is alkaline (basic). A change of 1 point in pH indicates a tenfold change in acidity (or alkalinity). In other words, a solution with a pH of 5.0 is 10 times as strongly acid as a solution with a pH of 6.0. A small amount of a strong acid, like hydrochloric acid, dissolved in neutral water, will produce a lower pH than

an equal amount of a weak acid like acetic acid. A small amount of a strongly alkaline material, like sodium hydroxide, dissolved in neutral water will raise the pH to a higher value than an equal amount of a weakly alkaline material like sodium bicarbonate. By neutral water is meant pure water or a neutral solution whose pH is 7.0. Due to the fact that it often contains dissolved carbon dioxide, which produces the ions of a weak acid, the pH of distilled water is often less than 7.0 and is therefore slightly acid.

In the cooling jacket of a Diesel engine and in the parts of the steam generator, water comes in contact with many different metals, the chief one of which is iron. One of the purposes of the treatment of water for use in Diesel cooling systems and steam generators is to prevent the loss of the metals through corrosive action of the water. Observations have shown that water with a pH below 7.0 is more corrosive to iron than water with a pH above 7.0 and that at a pH of around 9.6 the rate of corrosion of iron can be brought to a minimum if other interfering factors are controlled. Some of the other metals used have critical ranges of pH value in which corrosion is at a minimum and will be attacked at pH values which are either too high or too low. This one phase of the loss of metals due to corrosive attack can be controlled through the control of the pH of the water with which the metals come in contact. It is necessary to know what metals are present and will be contacted by the water in order to establish the proper range of pH control for a cooling or heating system. It is also important to know the temperatures which will prevail.

Obviously, the use of a number of different kinds of metals in the construction of the Diesel engine and their presence in the cooling system complicates the problem of selecting the proper pH range. There are also other factors involved which cannot be readily controlled by pH control alone, such as the action of bimetallic couples, and the action of oxygen which is usually present in the water. Fortunately, there are some materials available which have the ability to render the surfaces "passive" by laying down thin protective coatings on the surface. The use of these inhibitors makes the pH range less critical as between the various metals. The inhibitors themselves usually have a pH range within which they work best, and this is the pH range to control when they are used. The amounts of the inhibitors present and the pH should be checked regularly by chemical analysis so that adjustment can be made.

The use of the soluble alkaline chromates and control of the pH of the water between 8.5 and 9.5 have been found to give good results in the protection of Diesel engine cooling systems. In this type of treatment both the analysis for the amount of chromate present and the pH value of the cooling system water must be regularly checked and adjusted in order to realize the maximum benefit. In cases where water of zero hardness is not used, the control of pH does give an opportunity to effect minimum damage from either corrosion or scale formation.

The proper control of chemical treatment for Diesel cooling and heating systems can be realized only under the supervision of a competent chemist, and by the correlation of the records of analysis with actual inspection of the parts affected by someone who knows the aspects of corrosion.

Preparing For Snow Flanging

As winter approaches, what measures should the section forces take to prepare for the operation of snow plows and flangers? The mechanical forces?

Much Preparation Needed

By Roadmaster

Advance preparation must be made for snow removal long before its expected arrival so that any program for keeping the tracks open during storms may function efficiently. Many of the steps that are taken to insure safe and effective operation of snow plows and flangers are hardly more than normal good-maintenance practices. Not the least of these is providing for good drainage at road crossings, to prevent the heaving of the crossing material to a point where it might engage the truck-sides of flangers, plows, or other rolling stock.

Cuts where snow is expected to accumulate should receive the section force's preferred attention. Ditches should be cleaned so that water will flow freely, or freeze uniformly. Clean ditches are essential to the quick runoff of melted snow. Intermittent thaws and freezes after flangers or snow plows have been used are hazardous to any future plowing operations that may become necessary.

Not infrequently ties may have been distributed in cuts, and other contingencies prevented immediate installation. Such ties must be removed to preclude the possibility of their being struck by a snow plow. Any old ties that have been taken out of track of necessity late in the fall should be promptly disposed of.

Going hand in hand with the moving of crossties to safe locations is the general policing that should precede the snow season. This should be continued right up to and beyond the time of snowfall to insure that no broken drawbars, knuckles, etc., are left where they might be struck by a snow plow or flanger. Track material should not be distributed or used material left where it might create the same hazard. Broken rails should not be allowed to remain along the track where they, too, might be buried by snow, and create tripping hazards, etc.

Flanger signs, while not absolutely essential if those who are to operate the equipment know the territory, should be erected to designate permanent structures having close clearances. "Bootleg connectors" at signal locations, cut-sections, etc., should not be ignored as being obstructions. They may not endanger the operation of flangers but when torn off by such operation, their absence will disrupt train service as much as a heavy snow.

Any stand-by equipment, such as snow plows, flangers, etc., must be serviceable whenever needed. There should be a definite program prepared for the mechanical department to follow to assure that this equipment will function perfectly. Maintenance officers who have to use the equipment should check to see that it does.

Flangers, which may have been used during the summer for plowing cinders or other ballast may seem to be "temperamental" when they won't work at sub-freezing temperatures, but air cylinders may accumulate condensate and freeze. The mechanical department should be given opportunities to prevent such failures by adequate servicing of the equipment prior to the winter season.

Erect Flanger Signs

By T. H. Strate
Division Engineer, Chicago, Milwaukee, St. Paul and Pacific, Chicago

Prior to the time snow usually falls, flanger signs should be erected 100 ft. in advance and beyond any object extending above the top of tie, such as

a permanent crossing, a motor car set-off, a signal post, switches, railroad crossing, etc., to give the operator advance notice of the obstruction. Section forces should remove any farm crossing planks or similar obstructions that are not required for use during the winter.

All flangers, snow plows, wedge plows, etc., which are to be used for snow fighting should be carefully inspected and repaired by car department forces. Air lines, journal box packing, etc., should be given special attention. The section forces should equip the cars with an emergency set of tools, and should make sure that they have the right flanging blades and necessary plates for the sizes of rail over which the equipment is to be operated.

Where plows have air cylinders, the cylinders should be thoroughly cleaned of all condensation or water which may have accumulated during the summer and a small amount of alcohol or anti-freeze solution should be applied to prevent this condensate from freezing.

Stoves or other heating arrangements should be in order and correctly installed. All windows, headlights, etc., should also be put in working conditions.

Oxyacetylene Flame Cleaning

What are the advantages or disadvantages of oxyacetylene flame cleaning and drying of railroad bridges? Explain.

Surpasses Older Methods

By J. F. Salmon
Bridge Engineer, Canadian National Railways, Toronto, Ont.

Briefly, I consider the oxyacetylene cleaning and drying of steel railroad bridges, etc., to be efficient, generally economical and a great advance over the laborious wire brushing or most other mechanical methods of cleaning corroded steel structures. The broad, flat, pressure flame quickly loosens and forces away the old paint, rust, or accumulated scale and leaves the surface of the steel dry and clean for immediate application of the new protective coating. Parts inaccessible to wire-brushing are readily reached by the flame, and little, if any, of the more stubborn patches have to be removed by hand methods. Flame cleaning, especially due to the quick drying of the surfaces cleaned, permits an extension of the painting season, so long as the air is free from frost.

Oxyacetylene flame cleaning should be carried out by careful, experienced or tutored workmen, under the close supervision of the foreman. Excessive, continuous, or too-close flaming of an area could seriously damage the steel, and this might be the result of carelessness or of an effort to make an unnecessarily thorough job of clearing stubborn patches or pittings.

The so-called disadvantages of oxyacetylene cleaning are more or less common to all bridge jobs using mechanical equipment. The handling and securing of pressure tanks and connecting equipment on a bridge or scaffold, particularly in unfavorable weather, together with the necessity of keeping up reserves, is always in the picture. As in the use of all pressure gases, there is need for reasonable care with respect to keeping the flame away from inflammable materials and timber decking.

The foregoing is just my general opinion on the flame cleaning of steel, but I would consider the B. & B. foreman or paint foreman as the best authority on the practical problems covered by the question as to the advantages and disadvantages of such cleaning and drying of railroad bridges.

Insofar as the Central region of the C.N.R. is concerned, flame cleaning, while quite extensively used, is not our universal practice, because we continue to apply rust-retardants and oil coatings to steel bridges under normal conditions. However, as stated above, for thorough cleaning of corroded spans and turntables, the oxyacetylene flame is found to be very satisfactory.

Works Best For Priming

By A. E. Bechtelheimer
Engineer Bridges (Retired), Chicago & North Western, Chicago

In principle, the flame-cleaning, or as sometimes designated, "flame-priming" process consists of "scrubbing" steel surfaces with a series of closely spaced oxyacetylene flames that have an extremely high temperature and velocity. As a result, mill scale, rust coatings, and corrosion scale that is not tightly bonded is popped loose by sudden thermal expansion. Both physically absorbed and chemically combined water are driven off from any rust or scale that is present, leaving stable oxides in their places. The surface is then swept or wiped free of loosened foreign material and painted while still at an elevated temperature.

This procedure brings about improved corrosion resistance of the paint coating, increases cleaning and painting rates, and reduces setting time for the paint. Painting can be carried out under conditions of low temperature or dampness, which, otherwise, would cause major delays.

The practical application of this procedure presents two possibilities to railroad bridge engineers, that is, application to new structures in the fabricating shop and to others already in service. Obviously, flame-priming as a corollary to fabrication would furnish an ideal surface for the application of the priming coat of paint. Should this be found unfeasible in the shop, then delivery of the fabricated material could be made without the shop coat, and the flame-priming and painting carried out by and under direct supervision of company forces. In any event, flame-priming and painting should proceed as a continuous operation. The operator handling the flame-priming blow pipe should be followed immediately by the helper sweeping down the surface and, in turn, be followed by the painter. The heat increases the mobility of the paint and hastens the evaporation of its solvents. Since the highest temperature occurs at the surface of the metal, the solvents are not trapped by any skin formation, and, consequently, voids and blisters are less frequent. Further, the baking action of the heat has a beneficial effect upon the paint film.

When applied to bridges already in service, the process is more effective for cleaning and drying than for priming. Its best application can be made on a surface where the paint film, for all practicable purposes has been destroyed. It works equally well on a steel surface where the paint film is thin, dry, broken and peeling, and where rust and a small amount of corrosion exists. This is understandable when one considers the principles of flame-cleaning which, as previously stated, depend upon thermal expansion induced by high-temperature, high-velocity flames to loosen particles not tightly bonded to the steel. An actual paint film which may exist must be consumed and the residue removed to expose bare steel. This can be done more economically by burning torches or by other means than by the flame-cleaning blowpipe.

Large flat surfaces are best suited for flame cleaning. Small members and thin edges are more difficult to

clean. It is effective around rivet heads and in corners where the direction of the flame is normal, or nearly so, to the surface receiving it. A recent job, successfully flame-cleaned, consisted of laced columns in a large train shed, where some of the columns had drain pipes inside of them. There was heavy rust and scale and very little paint on the inside. Ordinary cleaning tools were not effective because of the restricted working space. The oxyacetylene flame did a thorough job of cleaning at reasonable cost. Painting was done while the steel was warm and dry. Since flame-priming heads range in width from 1 in. to 12 in. it was easily possible to select the head best suited to the restricted working space. Recent examination of this work shows the cover coat of paint damaged in many spots where baggage trucks have struck the columns while the red lead priming coat at these spots is still in good condition.

Checking Pneumatic Tampers

How important is it to check the air consumption of pneumatic tie tampers? How and when should this be done?

Checks Are Very Important

By H. L. Kent
Manager, Railroad Department, Ingersoll-Rand Company, New York

Periodic checks on the air consumption of pneumatic tie tampers is very important. The cost to replace or repair the worn parts which cause excessive consumpton of air is nominal and results in appreciable saving in the cost of compressor operation. Too often, compressors used for tie-tamping operations are larger than they would have to be if attention were paid to excessive air consumption of the tools due to wear.

A check of tamper air consumption at the end of each tamping season is economical. Repairs involving merely replacement of worn parts can be made quickly and cheaply in railroad maintenance shops. Manufacturers of pneumatic tampers are equipped to make replacements calling for reboring and fitting of oversize parts.

Sufficient attention paid to adequate lubrication during the working season greatly reduces the frequency of reconditioning.

Must Check Every Year

By E. H. Ness
Supervisor Work Equipment & Welding, Erie, Cleveland, Ohio

We believe an air consumption test of pneumatic tie tamping tools is very important. This is the only method we know of to determine if tools are using a greater volume of air than a compressor of a given size will deliver. Take for example the use of a compressor of 210 cu. ft. capacity with 12 pneumatic tampers. These tampers, when new, average 12 cu. ft. each, or a total of 144 cu. ft. The actual delivery of a two-stage compressor is rated about 85 per cent efficient, or at 178 cu. ft. actual delivery to the guns. This allows 34 cu. ft. surplus, providing compressor and guns are in 100 per cent condition. Therefore, if there are a few guns in the outfit which use more than 12 cu. ft. they consume more air than the compressor will deliver.

We believe tamping guns should be torn down; parts cleaned of carbon; pistons checked and cleaned; any worn parts replaced, such as split bushings, rubber buffers, etc.; and throttle valves checked for air leaks. This should be done at the end of each working season and guns should be tested for air consumption with a tool-om-eter, graduated from 0 to 100 cu. ft. for 80 lb. pressure. If the twelve tools are found to use air in excess of the amount that can be delivered by the compressor they are used with, then it is necessary to recondition the barrels by reboring and fitting them with oversize pistons. A barrel may be rebored twice. Usually the first boring of 0.010 oversize will take care of wear. The second boring is 0.020, after which it will be found necessary to completely renew the barrel and piston.

Use of Fire-Retardant Woods

To what extent can fire-retardant-treated woods and protective paints be used in railway buildings? Where can each be used to the best advantage?

Use Controls Flash Fires

By F. W. Gottschalk
Technical Director, American Lumber & Treating Co., Chicago

Flameproofed wood, treated by the vacuum-pressure process, is especially advantageous as a construction material for new buildings. The fire-retardant process adds another worthwhile property to wood, in addition to resilience, insulation, acid resistance and the ease of construction for which it is noted. The two most prominent applications of lumber so processed are in enginehouses and the superstructures of wharves.

Its use in the remodeling of existing depots and freighthouses is a smaller but recommended application. Flameproofed wood also serves well for fire cut-off walls in bridges, piers and barrier sections within warehouses and other large, open structures.

The principal advantage of pressure-fireproofed wood lies in its permanence and its protective properties against flash fire conditions.

Has A Number of Uses

By F. A. Hartman
Vice-President, Protexol Corporation, Kenilworth, N. J.

Pressure-treated, fire-retardant wood has comprised the bulk of the forest products supplied to railroads for use where fire resistance was a requirement. Generally speaking, the uses of protective paints are limited by mechanical wearing characteristics which necessitate that they be continually maintained. The high cost involved militates seriously against their use.

Pressure-treated fire-retardant wood has a great many uses in railway buildings. Being wood, it has all the natural characteristics inherent in timber. It is inexpensive, flexible, lightweight, and is generally available. Add to these characteristics a fire resistance which meets the re-

quirements of various fire insurance underwriters, and you have a material which can be used almost without restriction. Incorporating high fire resistance, together with a protection against decay provided by a standard salt preservative, the wood is left clean and paintable and can be used at almost any point where protection against the spread or penetration of fire is important. The need for this material necessitated the development of a specification by the A.R.E.A., which may be found on Page 172 of the 1944 Proceedings. This specification provides that the material shall be treated to conform to the fire-test requirements of Specification C 160-46 of the A.S.T.M. and, at the same time, shall have incorporated any standard salt wood preservative in the retention specified for A.R.E.A. purposes. Therefore, this combination treatment will readily render every possible protection against the primary agencies of destruction associated with untreated lumber.

Such fire-retardant and decay-resistive lumber has been supplied to a large number of railroads where it is now serving structural and sheathing purposes in shops, enginehouses, locomotive sheds, stations, freighthouses, trestles, piers, coal sheds, as tunnel lining, and for protection boards and fire curtains. It is also being used increasingly for millwork and as a finishing material in the stations and ticket offices of railroads that are modernizing many of their facilities.

The fact that wood has high resistance to the corrosive fumes of steam locomotives is well known. The fire hazard of steam locomotives per se is likewise recognized. It might seem that as the popularity of Diesel locomotives increases, the fire hazard in enginehouses and shops could be expected to drop. This is not true. Diesels consistently leak oil which accumulates dust, and the existence of generators, auxiliaries, batteries and motors make Diesels a fire hazard in themselves. The structures in which they are serviced should be designed to limit the spread of any incipient fire. This can be accomplished readily in existing buildings by the installation of fire walls segregating each set of tracks. These can be constructed by using 4 by 6 studs to which nominal 2-in. plank can be nailed. When treated according to the above-mentioned specification, this construction has a rating of ¾ hour against flame penetration. Such construction is readily installed at relatively low cost.

The many uses to which railroad engineers have put fire-retardant wood have been developed after considering the merits of such treated wood in comparable installations. It is here that the experience of the treating concern is of value. The mere fact of continued use indicates that operating units can be brought more nearly to perfection through the use of fire resistance in railroad construction.

Maintaining Insulated Joints

*What are the special problems presented by insulated joints in track? How can these best be avoided or overcome?**

Short Rails Increase Work

By R. G. Simmons
General Track Inspector, Chicago, Milwaukee, St. Paul & Pacific, Chicago

The insulated joint has always presented several track problems. I think the first of these to consider is that created by having to locate insulated joints in exact locations so they will function properly. This usually makes it necessary to cut and drill special-length rails. Quite often these are shorter than is desirable to have in a high-speed railroad. It is also frequently necessary to square up insulated joints at signal locations and cut-sections. This creates probably the most undesirable condition of all because square joints are very difficult to maintain. All square joints possible have been abolished from the main lines of important railroads for many years and the few that remain due to necessity, greatly add to the maintenance expense. Often the rail ends become battered due to the joints being square and the only way to remove such bad spots from the railroad is to renew the rails.

Where it is necessary to cut rails in the field to locate joints, caution must be taken so that the cut end, when made with hammer and chisel, is not used as a part of the insulated joint, as the cut rail is usually rough and will soon wear out the fibre insulation in the joint.

The fibre insulation used in assembling insulated joints has been improved greatly in recent years, but due to heavy traffic and weather action the fibres wear out quite rapidly and must be renewed. This renewal is quite a problem, especially where the end post has to be renewed, because it requires special tools and close supervision from both the signal and track departments.

Since it is necessary to have insulated joints, much thought should be given the subject by all concerned so that the number of joints will be kept to a minimum and as few as possible located where they will be a source of increased maintenance expense.

Drainage Is Essential

By R. L. Baucom
Engineering Department, Missouri Pacific, St. Louis, Mo.

It is generally recognized that rail joints are the weakest sections of track, and that their adequate maintenance is necessary to a smooth riding railroad. It tends to follow, then, that insulated joints, because of the factors affecting their construction, location, etc., require more careful maintenance than the ordinary rail joint. All of these factors present special problems to maintenance crews. A maintenance of way rule which recognizes and emphasizes the importance of adequate maintenance of insulated joints states, in substance, that the section foreman and signalman are held jointly responsible for their maintenance.

I believe that good drainage is of the first importance in the care of insulated joints. No water or sloppy ballast should be allowed to exist around insulated joints because it may result in ineffectual insulation for the track circuit. Next in importance is the use of two good joint ties, kept solidly tamped and properly spaced, so as to give good bearing to the abrasion plates and the joint. If the two foregoing factors are taken care of satisfactorily, then the next step—that of maintaining the fibre insulation—will become minor in importance.

Satisfactory maintenance, of course, includes keeping the bolts tight at all times. It must also be remembered that the ends of the rail must be smooth and free from burrs or sharp

*Additional material has been received on this question but, because of its scope, is being withheld for publication in a subsequent issue.

edges. In an emergency, when it is necessary to cut a rail with a chisel, the end which is cut should never be placed in an insulated joint. It is also quite important to apply a sufficient number of rail anchors for some distance on each side of an insulated joint to prevent running rail from excessively cutting the fibres of the end insulation.

Portable Wood-Working Tools

What are the advantages or disadvantages of equipping building forces with portable wood-working equipment larger than hand-held tools? What is the best way of moving such equipment from job to job?

Sees No Advantage

By R. W. Johnson
Assistant Engineer, Chicago, Milwaukee, St. Paul & Pacific, Chicago

As a general proposition, there is no great advantage in using portable equipment larger than hand-held tools in maintaining buildings. The largest maintenance of buildings is in important terminals, which are usually the headquarters for division forces, including building supervisors. These men maintain shops with permanent installation of wood-working equipment. All timber requiring framing which cannot be done economically by hand-held tools on the job is transported by truck to these shops and returned by the same means after the shop work is completed.

In erecting new buildings of considerable size there could, no doubt, be economic advantages in setting up a wood-working plant on the job, but of late years such buildings are done by contract, as most building forces have all they can do to handle ordinary maintenance work.

Many Possible Advantages

By General Building Supervisor

Somehow or other the question of using relatively large units of portable wood-working equipment was brought into a conversation I had with a general building contractor the other day. He said he did not see how railroad building departments could afford to do without portable wood-working equipment. The only alternative, in his opinion, was to give the business to him so he could use his own equipment.

He knew that some railroads had large, well-equipped divisional carpenter shops, but said he could see an analogy between such shops and those run by lumber yards, where customers had to wait their turn for something they should have had at once.

I told him of the portable shops which had been built into old baggage cars. He thought that would have been a good idea 30 years ago, but in view of recent developments said they were too cumbersome, too expensive, and not portable in the sense in which he used the word.

After picking those flaws in railroad practices, he extolled the merits of his own portable equipment and dared me to find fault with any of it. One of these he described as a portable shop, mounted on a specially designed trailer riding on two rubber-tired wheels. He said the unit was less than three feet wide, less than six feet high, and could be moved by two men in and out of standard doors. The trailer houses a radial saw, extension table, 100 ft. of electric cable on a reel, tools, etc. When the saw is set, built-in jacks take the weight off the wheels and springs.

Another unit combines a table, arbor and power drive in a single rotating unit. In this machine all cuts are made with the lumber remaining length-wise on the extension table. It is gasoline-engine driven, but can be obtained with an electric drive. He claimed it could be used for mitering, tenoning, bevel ripping or compound mitering. This unit has a 12-in. blade, can rip 4 in. deep and 40 in. wide, or can cross cut a 3-in. by 12-in. or a 4-in. by 4-in. timber. Still another of his units was driven by a flexible shaft and could make cuts up to 15 in. wide and 3 in. thick. It also could perform many types of work.

While my friend admitted that these outfits would effect the largest savings if used for new construction, he said he thought they could be economically justified for modernization jobs and heavy maintenance. He closed his argument by reminding me of the time I had to call for his assistance when I had to renew a large number of old doors and windows which were not standard in size and which could not be replaced by the local supply houses. He laughingly added that we almost paid for one of his portable units on that job. Maybe he is right.

More on Rail Corrugations

By H. Austill
Chief Engineer, Terminal Railroad Association of St. Louis, St. Louis, Mo.

May I add my bit to the discussion on causes of corrugated rail appearing on page 998 of the October issue of *Railway Engineering and Maintenance?*

Assuming that the coning on the wheels is perfect, there is but one degree of curvature where the wheels on the inner rail do not slip as a train goes around the curve. In that case, the difference between the lengths of the inner and the outer rails of the curve is equal to the difference between the distances traveled by points on the circumferences of the wheels at the line of contact with the heads of the rails.

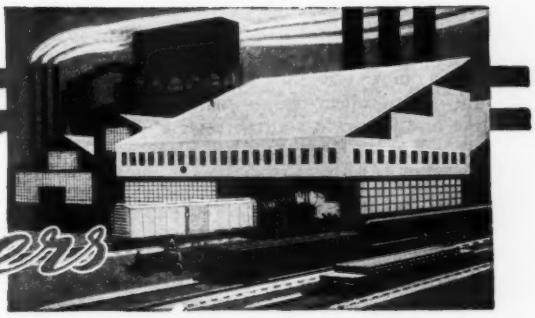
So long as wheels in railway equipment are fixed on the axle and have the treads coned, there must be a slipping on the rail that is in proportion to the diameter of the wheels at the line of contact with the head of the rail. As the flange of one wheel is against the gage side of the rail, the opposite wheel is of less circumference at the point of contact with the rail head and, certainly, one wheel must slip as they revolve. The slipping, be it on tangent or curve, is not necessarily all longitudinal, but because of the play in the trucks it may occur in jerks or it may occur diagonally.

Certain track conditions, such as wide gage or low joints, are conducive to bringing the flanges against one or the other rail, or first one and then the other rail, producing a so-called wandering of the cars.

Generally, corrugated rail is found near locations where brakes are frequently applied so that the wheel treads are quite hot.

At least I do not think it has ever been conclusively proved that corrugations in rails do not have their origin in wheel slippage, or that the hard ridge is not the original rail surface that is left after the troughs are cut out by the grinding action of slipping wheel treads.

PRODUCTS of Manufacturers



(For additional information on any of the products described in these columns, use postcards, page 1077)

Utility Jackhammer

A NEW rock drill, designated as the J-10 Utility Jackhammer, has been announced by the Ingersoll-Rand Company, Phillipsburg, N.J. This new air-operated drill has been designed

Drilling Masonry with the Ingersoll-Rand J-10 Jackhammer

for general utility and maintenance work. Weighing only 14 lb., the new drill is 17⅛ in. long, with a ⅞-in. by 3¼-in. shank, is equipped with automatic rotation, and uses standard jackbits.

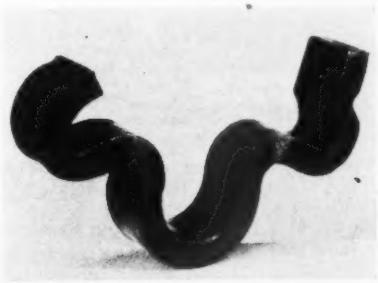
By removing the rotation pawls or using round-shanked tools the drill may be used as a light paving breaker or for chiseling and channeling. Throttle control is said to permit the selection of exactly the right kind of blow for the work involved. A built-in oil reservoir in the handle is said to supply ample lubrication. Standard equipment includes a ⅞-in. hexagonal drill rod 14 in. long; three standard jackbits—1¼ in., 1⅜ in. and 1½ in.; one star-drill adapter; two set-screw wrenches, and a half-pint oil can. Accessories for the Jackhammer include a twist-drill adapter, fibre carrying case and air hose and clamps.

The new utility hammer is said to be particularly adaptable for drilling with either star or twist drills, cutting holes in masonry, paving breaking and other work usually confronting maintenance crews. Due to its light weight, the Jackhammer is said to be readily portable and easy to use from scaffolds and ladders, and in corners.

Improved Rail Anchor

THE Woodings Forge & Tool Co., Verona, Pa., has announced an improved rail anchor, known as the Woodings Advanced Type Rail Anchor. The improved anchor is a refinement of the former design and incorporates a number of new features.

The principal change in design is the provision of two grip jaws of equal spacing, one on each side of the rail base. Each of these jaws is provided with a facet which engages the top radius of the rail base, permitting the anchor jaw on each side to slide in or out to compensate for tolerances in the rail-base dimensions. The anchor was designed with this sliding action for the purpose of permitting it to adjust itself immediately to the rail base so that four equally-spaced contacts are made between the anchor and the rail. The Woodings Forge & Tool Co. indicates that the new design provides additional holding power and increases the ease of application.



The Woodings Advanced Type Rail Anchor

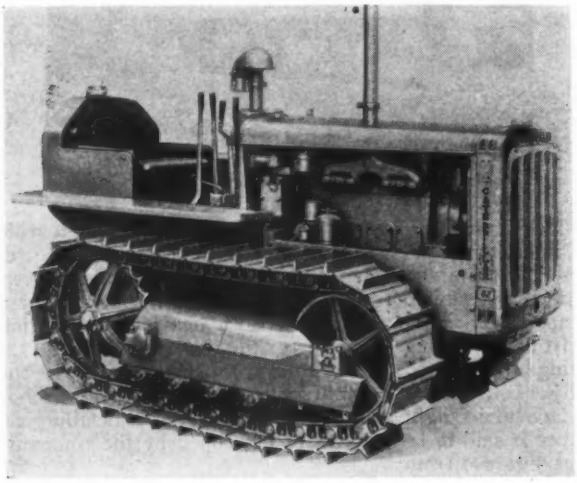
The improved anchor is of a wide steel section, the purpose being to reduce the possibility of derailed wheels punching the anchor through the base of rail. Also a heavier steel section is used for the wider rail bases (112-lb. and over). Incorporated in the manufacture of the improved anchor are new mechanical and metallurgical processes developed by the company.

Caterpillar Engine, Tractor and Motor Grader

THE Caterpillar Tractor Company, Peoria, Ill., has announced the development of a new four-cylinder, Diesel engine (Model D311), a new Diesel track-type tractor (Model D2) and a new motor grader (Model 212). The new D311 Diesel engine, which is the focal point in the power increases which are found in the new tractor and motor grader, replaces the D3400 model in the company's line of industrial motors. It is said to develop a maximum output of 49 hp. at 1700 r.p.m. In addition to being the power unit of the new tractor and motor grader, the new engine is available for industrial power, as an electric set and as a marine engine.

Refinements of the new engine, according to the manufacturer, are: A ¼-in. larger bore, resulting in an increase to 252 cu. in. in piston displacement; the application of stronger connecting rods and heavier, stronger crankshaft; chrome-plated top piston rings for longer life; divided manifolding to allow an independent port for each valve, thus improving the flow of incoming air and exhaust gases; an improved oil-pressure control system assuring maintenance of proper oil pressure at the bearings even for extreme cold weather starting; and a new fuel injection valve design, with the pressure-operated valve mechanism enclosed in a copper capsule, easily replaceable as a unit, with no overflow lines required. In addition, the new engine is fitted with

a larger and more efficient air cleaner, which is said to retain the advantages of an oil bath with a swirl-type precleaner; a new governor equipped with anti-friction bearings, to provide sensitive and accurate control; and a



The New Caterpillar D2 Crawler-Type Tractor

three-tube type oil cooler mounted beside and flush with the water radiator core, which is said to provide more effective cooling of the lubricating oil and water, to facilitate servicing, and to simplify the installation of blower fans.

The new D2 tractor is said to have 32 drawbar horsepower and 38 belt horsepower, an increase of 24 per cent over its predecessor. In addition to the improved engine, the use of new, harder metals and better heat treatment is said to have brought to the tractor an improved transmission, final drive and clutches.

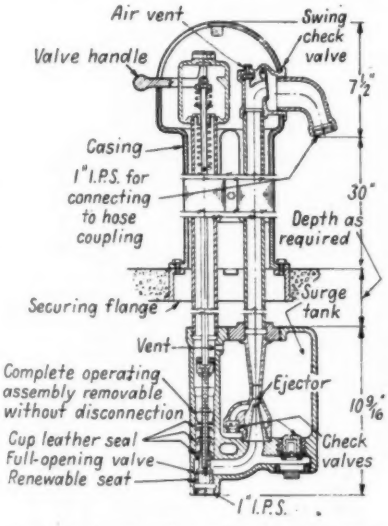
The new No. 212 motor grader is rated at 45 hp., which is said to be a 29 per cent increase in power over the previous grader of this size and weight. Other advantages incorporated in the new grader are said to include power-operated mechanical controls equipped with anti-coasting brakes to prevent creeping or coasting under load; increased speed in all ranges of a four-speed transmission; and an arched front axle to provide maximum clearance.

Coach-Watering Hydrants

THE J. A. Zurn Manufacturing Company, Erie, Pa., is offering a non-freezing, post-type hydrant which has been designed exclusively for coach-watering purposes, and which is said to conform to the revised provisions of the United States Public Health Service. This hydrant is said to assure continuous operation in the coldest weather by operating on a dry-pipe principle, which permits the water from its riser pipe, which is above ground, to return after operation to a surge tank beneath the frost line.

Each time the hydrant is used, the surge tank is emptied by a built-in ejector. Check valves are said to protect the operating cycle against any possibility of flooding under extreme back pressures, or from the return of excess hose water.

The surge tank and operating valve assembly are built as a unit which is attached at its bottom to the water supply pipe. Two pipes are attached to the top of this unit. One, a riser pipe, receives the water from the ejector and conveys it through a swing check valve located at the top



Cross-Sectional View of Zurn Post-Type Coach Hydrant

of the pipe to an outlet spout to which a hose may be coupled. The other pipe encloses a rod and spring mechanism by which a handle at the top of the hydrant can operate the valve. This operating valve is called "quick acting" because it has only two positions —fully-opened and fully-closed. This feature is said to assure positive emptying of the surge tank. When the valve is closed, residual water in the riser pipe drops into the surge tank.

A cast iron casing entirely surrounds all the pipes and mechanisms that are above ground, except the valve handle and delivery spout. This casing is bolted to a "securing flange" which is set in concrete at the ground level and through which the pipes lead from the surge tank unit. The designers claim that this construction makes cross connection to sewers not only unnecessary but impossible.

The surge tank unit, if desired, can be used in connection with a service box, flush with the ground level for enclosing the valve handle and water outlet.

Floodlight Unit

TO provide adequate lighting for night construction or emergency work, the Arrow Supply Company, Pittsburgh, Pa., has developed a portable 3,000-watt light tower and generator unit, mounted on a ½-ton, all-steel utility trailer. The trailer, which is manufactured by The American Bantam Car Company, Butler, Pa., rides on two pneumatic-tired wheels, and is equipped with a welded steel canopy.

The Bantam Portable Lighting Unit Shown with the Floodlight Tower Secured in the Elevated Position

The power and lighting unit in-

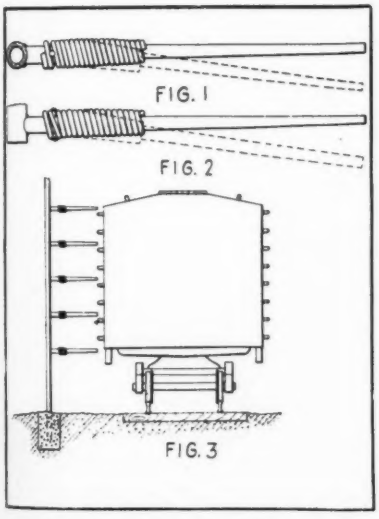
(For additional information on any of the products described on this page, use postcards, page 1077)

cludes an Onan gasoline-powered generator, welded to the steel bed of the trailer, and a welded steel tower which is mounted on a bracket at the front of the trailer and projects above it to a height of 18 ft. On top of the tower are two 1500-watt clear globes in pivoting reflectors, which may be adjusted to focus or spread the beam, as desired. The bracket for mounting the tower extends above the canopy on the trailer to about the mid-point of the tower, and the tower is connected to the upper end of this bracket by means of a hinge pin so that it can be placed in a nearly-horizontal position and secured for traveling, thereby reducing the road clearance to 9 ft.

The trailer is designed for operation over rough terrain and is said to remain in good balance both when being towed and when stationary and resting on a front log support.

Clearance Warning

THE Marshall Ross Company, Boston, Mass., is now offering a new type of side clearance warning known as the Marco side-clearance warning. This device consists of a number of "fingers" of hard rubber composition,



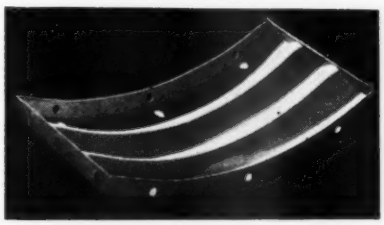
A Typical Installation (Fig. 3) of the Marco Side Clearance Warnings Welded to a Post, also Showing (Figs. 1 and 2) the Movement of the Fingers Horizontally and Vertically

each projecting horizontally from a specially designed coil spring, which, in turn, is attached to a steel support. The support is grooved so that it may be welded to a steel post, or to a plate for bolting to a wall or building. When applied to a post, wall, or building adjacent to the track, and at a suitable distance from a point of close side clearance, the fingers will contact men riding on the sides of cars, and warn them of the impending danger.

The spring permits the warning fingers to move in any direction, when contacted by a man, and causes them to return to the original position. A typical installation, according to the manufacturer, comprises a series of four or five such warning fingers spaced so as to encounter a man riding at any height on a car ladder. The Marco warning units are said to be internally secured to prevent tampering, and are constructed of rust and corrosion-resistant materials.

Tunnel Liner Plate

THE development of a new design of corrugated, tunnel-liner plates, said to possess great strength with respect to the weight of steel used, is



One of the New Young & Greenawalt Tunnel-Liner Plates

announced by the Young & Greenawalt Co., Chicago. The new plates are said to be fabricated in relatively small sizes, thus facilitating handling by one man. Each plate has a net covering width of 18 in. and the length of the plate may vary according to the requirements of the job, in general between 35 in. and 45 in.

The plates are fabricated from either USS Pure Iron or USS Copper Steel. They can be furnished either full galvanized after fabrication or left in the black, and either type can be asphalt coated. The corrugations are spaced 6 in., crest to crest, with depths of 1 in. to 2 in., as required for strength. The plates are joined together by means of 11/16 in. bolts, these being inserted through holes provided in flanges on each edge of each plate. The flanges are turned inwardly so that the plates may be assembled from the inside.

Safety Hand Tongs

THE Mack Welding Company, Duluth, Monn., has developed a tool for use in handling crossties and other timber members, known as the Mack Safety Hand Tongs. This tool, which is said to have a lifting capacity of 600 lb., is 15 in. long, is made of cast aluminum, and weighs 3 lb. It is composed of two principal parts, one of which is straight and the other curved. The straight part has a hand grip at one end, while the other end, divided to form two prongs, is fitted with two sharp points, one in each prong. This end of the member forms one jaw of the tongs. The other jaw is formed by the curved member, which is attached to the straight part by a pin connection of hardened steel. The outer end of the curved member is also fitted with a steel point. All three points are of tool steel and are replaceable.

To use a pair of these tongs it is placed in position with the points at the outer end of the straight member gripping the top surface of the timber to be lifted and the point at the end of the curved jaw gripping the vertical face of the end or side of the timber. The relative positions of the two jaws are such that the grip is tightened as lifting pressure is applied to the handle.

Handling Crossties From a Push Truck With the Mack Safety Hand Tongs

(For additional information on any of the products described on this page, use postcards, page 1077)

Changes in Railway Personnel

General

D. E. Beatty, superintendent on the Louisville & Nashville, with headquarters at Mobile, Ala., and formerly a roadmaster on this road, has retired. A native of Louisville, Ky., Mr. Beatty entered the service of the L.&N. at Paris, Tenn., as a rodman in the engineering deparment, on April 1, 1901. Subsequently he served as assistant engineer and as assistant roadmaster, interspersed with employment in the chief engineer's office at Louisville. In December, 1910, he was appointed roadmaster at Paris, being transferred to Nashville in August, 1917. On July 1, 1921 he was promoted to superintendent serving in this capacity at various locations until his retirement.

Engineering

George G. Amory, assistant engineer of the Chicago & Western Indiana, has been promoted to office engineer, with headquarters at Chicago, replacing **George C. Hughel,** who died on March 16.

E. Q. Johnson, assisant engineer on the Florida East Coast at St. Augustine, Fla., has been appointed engineer-supervisor on the Wabash, with headquarters at St. Louis, Mo.

B. Laubenfels, engineer of grade separation of the Chicago, Burlington & Quincy, has been promoted to the newly-created position of principal assistant engineer, with headquarters as before at Chicago.

F. R. Moore, communications engineer of the Atchison, Topeka & Santa Fe, at Topeka, Kans., has been appointed construction engineer. **Jack Morgan,** construction engineer, has been appointed assistant division engineer at Needles, Cal.

Bruce G. Packard has been appointed acting division engineer of the Black Hills Division of the Chicago & North Western, with headquarters at Chadron, Neb., to serve during the illness of **W. V. Kerns,** division engineer at that point.

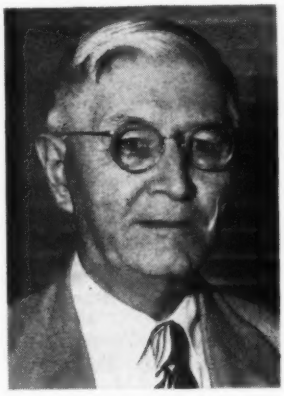
E. H. Sickels, office engineer in the office of the chief engineer of the Eastern region of the Pennsylvania, has been granted a four months leave of absence, beginning November 1.

J. H. Hunter has been appointed division engineer on the Atlantic Coast Line, with headquarters at Savannah, Ga.; **A. V. Hooks** has been appointed division engineer, with headquarters at Rocky Mount, N.C.; and **J. Roy Ivey, Jr.,** has been appointed office engineer at Savannah.

M. C. Jennette, engineer maintenance of way of the Norfolk Southern, has been appointed chief engineer, with headquarters as before at Norfolk, Va. The office of engineer maintenance of way has been abolished. A photograph of Mr. Jennette and a sketch of his career were published in *Railway Engineering & Maintenance* for August, page 788, in connection with his appointment as engineer maintenance of way.

H. F. Reilly, division engineer on the Lehigh Valley a Jersey City, N. J., has been appointed engineer maintenance of way, with headquarters at Pier 8, North River, New York, and **C. W. Baker,** supervisor of bridges and buildings at Buffalo, N.Y., has been appointed division engineer at Jersey City, succeeding Mr. Reilly.

W. H. Vance, whose retirement as assisant engineer maintenance of way on the Missouri Pacific, with headquarters at St. Louis, Mo., was reported in the October issue, was born at Effingham, Ill., on November 6, 1876, and was graduated by the University of Illinois in 1899 with the degree B. S. in C. E. He entered rail-



W. H. Vance

road service in 1902 on the Peoria & Eastern, at Indianapolis, Ind., and became assistant engineer on the Missouri Pacific at Poplar Bluff, Mo., in 1905. From 1906 to 1917 he served successively as division engineer, engineer maintenance of way, and chief engineer on the Louisiana & Arkansas, at Stamps, Ark. In 1917 he was appointed engineer maintenance of way on the St. Louis Southwestern, at Tyler, Tex. Under the federal administration of the railroads he served as district engineer at St. Louis, and as engineer maintenance of way at Tyler. On March 1, 1920, Mr. Vance was appointed district engineer on the Missouri Pacific, with headquarters at Little Rock, Ark., and on March 1, 1926, he was advanced to assistant engineer maintenance of way, at St. Louis, the position he held at the time of his retirement.

E. A. Johnson, chief designer in the bridge department of the Illinois Central at Chicago, has been promoted to assistant engineer of bridges, with the same headquarters, succeeding **M. Block,** whose promotion to engineer of bridges was reported in the September issue.

F. X. Fischer, instrumentman on the Chicago, Burlington & Quincy, with headters at Aurora, Il|., has been promoted to division engineer at Hannibal, Mo., to succeed **R. C. Russell,** who has been transferred to Aurora to replace **C. J. McCarty,** who has retired under the pension rules of this company after more than 42 years of service.

A. B. Chaney, whose appointment as assistant engineer maintenance of way of the Missouri Pacific, with headquarters at St. Louis, Mo., was reported in the October issue, was born at Magazine, Ark., on October 10, 1892, and received his higher education at the University of Mis-

A. B. Chaney

souri. He began his railroad career in 1906, and served in various minor capacities on the Chicago, Rock Island & Pacific, the Missouri Pacific, and the Southern Pacific. In 1914 he was appointed rodman on the Missouri Pacific, and served in that capacity, and as instrumentman, ballast inspector, and rail inspector until 1917, when he entered the armed forces of World War I. Following the war Mr. Chaney was appointed roadmaster on the Missouri Pacific at Paris, Ark., in 1920; assistant engineer, at Van Buren, Ark., in 1922; and division engineer, at McGehee, Ark., in 1929. He was transferred to Wynne, Ark., in 1931, and Poplar Bluff, Mo., in 1933. In 1936 he was advanced to district engineer, with headquarters at Little Rock, Ark., the position he held at the time of his recent promotion.

William L. Seabridge, general foreman in the track department of the Atchison, Topeka & Santa Fe, has been promoted to assistant division engineer, with headquarters at Fresno, Cal., succeeding **J. M. Terrass,** who has been appointed assistant engineer at Los Angeles, to replace **R. V. Glover. Jack Morgan,** assistant engineer on special work at Houck, Ariz., has been appointed assistant division engineer at Needles, Cal., to succeed **H. E. Preece.**

Richard W. Willis, whose retirement as assistant chief engineer of the Chicago, Burlington & Quincy, with headquarters at Chicago, was announced in the October issue, was born on July 27, 1874, at Charles Town, W. Va. Mr. Willis received his education at Charles Town Academy and at the Virginia Military Institute. He entered railway service in May, 1896, with the Lake Shore & Michigan Southern (now part of the

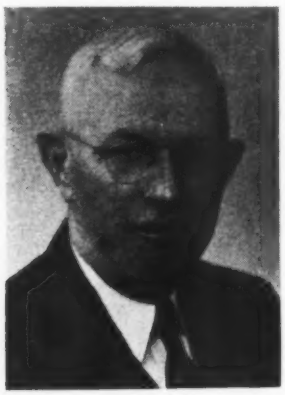
(*Continued on page* 1140)

(*Continued from page* 1138)

New York Central). On April 1, 1898, Mr. Willis entered the service of the Burlington at Galesburg, Ill., later serving as instrumentman and division engineer at the same point. Later he served as engineer of the Missouri district at St. Louis, Mo., and as engineer of the Illinois district at Chicago. In 1939 he was promoted to principal assistant engineer at Chicago, and in July, 1946, he was further advanced to assistant chief engineer, which position he held until his retirement. Mr. Willis is widely known as a designer of railroad yards and terminals, and most of the principal yards and terminals that have been built on the Burlington during the past quarter century were designed and constructed under his supervision.

Richard W. Willis

James S. Findley, division engineer on the Chicago, Burlington & Quincy at Denver, Colo., has been promoted to locating and construction engineer with headquarters at the same point, in which position he will be in charge of the relocation and construction of several branch lines in the vicinity of the Harlan County dam. Mr. Findley was born on January 3, 1889, at Peabody, Kan., and obtained his higher education at Friends University, Wichita, Kan., and the University of Illinois, graduating with a bachelor of science degree in civil engineering from the latter school in 1912. He entered railway service in the same year as a concrete inspector on the Kansas City Terminal, holding this position until January, 1915, when he became a bridge and building inspector on the Missouri-Kansas-Texas, serving at Parsons, Kan., and Eufaula, Okla. He entered the service of the Burlington in July, 1916, as an instrumentman at Denver, holding this position until July, 1918, when he was promoted to division engineer of the Casper Division with headquarters at Greybull, Wyo. Subsequently Mr. Findley served in the same capacity on the Sheridan and McCook divisions.



James S. Findley

Lionel E. Peyser, principal assistant architect of the Southern Pacific at San Francisco, Cal., has been promoted to architect there, succeeding **John H. Christie,** who has retired after 43 years of service. Mr. Peyser is succeeded by **William F. Meaney. Eldon H. Cofer** has been appointed office engineer at San Francisco, succeeding **Herbert A. Lathrop,** who has retired.

Mr. Christie was born on April 1, 1878, in Germany, and began his railroad career with the Pittsburg, Shawmut & Northern in 1902. Two years later he joined the S.P. as a draftsman in the engineering department at San Francisco, and in 1909 was appointed head draftsman.

Lionel E. Peyser

Mr. Peyser was born on October 15, 1885, at Stockton, Cal., and entered railway service on June 10, 1917, as an architectural draftsman in the general offices of the Southern Pacific at San Francisco. On February 16, 1923, he was appointed architectural designer, and on June 1 of the same year he became leading designer. On July 1, 1927, Mr. Peyser was promoted to assistant architect and on March 16, 1943, he became principal assistant architect.

Special

C. T. Blume has been appointed general supervisor of work equipment of the St. Louis-San Francisco, with headquarters at Springfield, Mo.

Bernard Geier has been appointed supervisor of work equipment and welding, a newly created position, on the Delaware, Lackawanna & Western.

W. H. Sims, whose appointment as supervisor of reclamation of the Chesapeake & Ohio, with headquarters at Barboursville, W. Va., was reported in the October issue, was born at Red Sulphur Springs, W. Va., in 1907, and began his railroad career in 1924 as a signal helper with the Chesapeake & Ohio. In 1927 he became a signalman with the Atchison, Topeka & Santa Fe, and returned to the C. & O. in 1928. Subsequently he has served as signalman, signal maintainer, signal foreman, and signal inspector, the last being the position he held at the time of his recent appointment as supervisor of reclamation, at Barboursville, W. Va.

W. H. Sims

R. K. Johnson, whose appointment as superintendent of work equipment and reclamation on the Chesapeake & Ohio, with headquarters at Barboursville, W. Va., was announced in the October issue, was born on March 5, 1898, at Rodgersville, Tenn., and received his education in the public schools and through a series of correspondence courses. His railway career began in 1916, when, during his summer vacation, he worked as a signal helper on the Wabash. Upon completing his school work he re-entered the service of the Wabash in 1917 as a signal helper, and later in the same year, left the railroad to become connected with the Western Union Telegraph Company. In 1918 Mr. Johnson entered the employ of the Ches-

R. K. Johnson

(*Continued on page* 1142)

So many uses—

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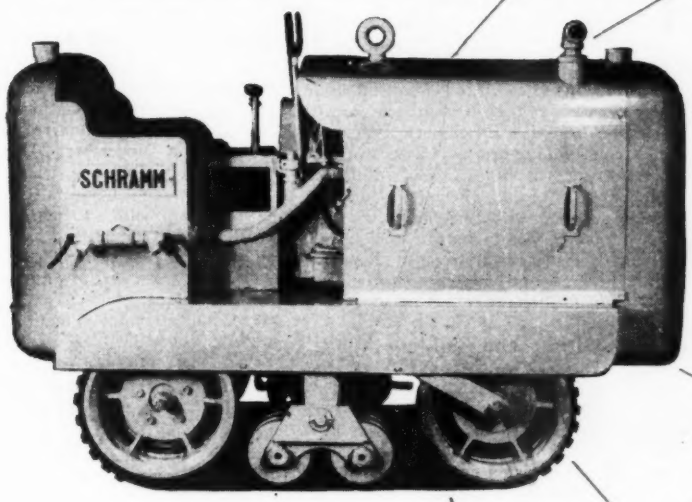
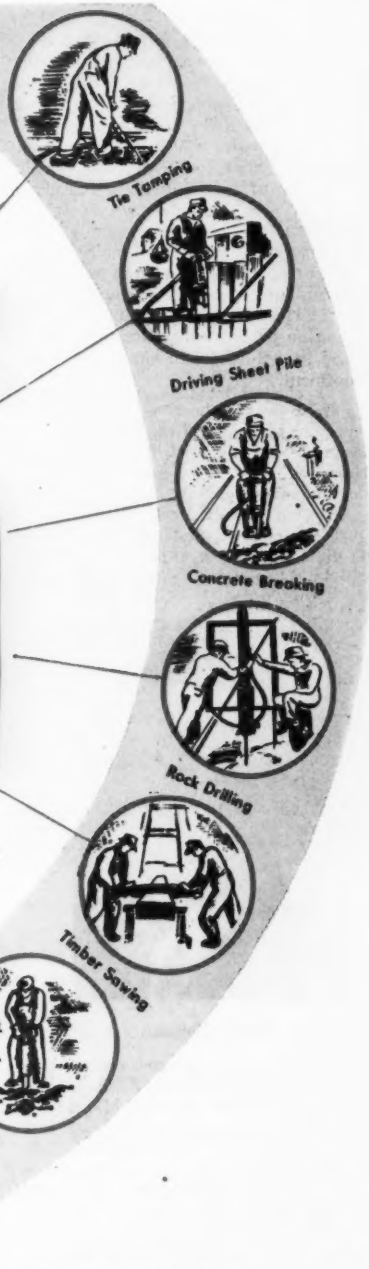


. . . a hard hitting off-track compressor that goes anywhere



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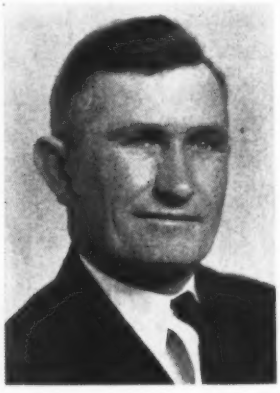
(*Continued from page* 1140)

apeake & Ohio as a signalman, later leaving the company to join the Indiana Bell Telephone Company. After serving this company as a lineman, telephone repairman and switchboard repairman, he returned to the Chesapeake & Ohio in 1920 as a signal maintainer, and in January, 1923, was appointed acting supervisor of signals and water supply, with headquarters at Peru. In June of the same year, Mr. Johnson was appointed supervisor of signals and water supply at Peru. He was appointed supervisor of reclamation on November 16, 1937, which position he held at the time of his latest appointment.

H. D. Bowen, whose appointment as supervisor of work equipment on the Chesapeake & Ohio, with headquarters at Barboursville, W. Va., was reported in the October issue, was born at Gimon City, Mo., on July 31, 1898, and from 1916 to 1920 served as a machinist apprentice with the United Iron Works, at Springfield, Mo. He entered railroad service in



H. D. Bowen

1920 as a machinist at the reclamation plant of the St. Louis-San Francisco, at Springfield. On June 24, 1924, Mr. Bowen entered the service of the Chesapeake & Ohio at that road's reclamation plant, and was promoted to lead machinist on July 31, 1931. He was appointed machinist foreman in 1938, and in 1940 he was advanced to general foreman, the position he held at the time of his recent appointment.

L. W. Ross, whose appointment as assistant to the superintendent of work equipment and reclamation on the Chesapeake & Ohio, with headquarters at Barboursville, W. Va., was reported in the October issue, was born at Hinton, W. Va., in 1895, and received his higher education at the University of Kentucky and through the International Correspondence Schools. He entered the service of the Chesapeake & Ohio in 1917 as a pass clerk in the office of the general superintendent, at Huntington, W. Va., and later served in various capacities in the offices of the statistician, timekeeper, and superintendent. During 1925 he was transferred to the reclamation plant at Barboursville, W. Va., where he was employed as material clerk, and, later, as chief clerk, holding the latter position until recently.

Track

J. R. Kanan, assistant engineer of track of the Ft. Worth & Denver City, with headquarters at Ft. Worth, Tex., has had his jurisdiction extended to include the Colorado & Southern.

J. B. Leaverton, assistant roadmaster on the Atchison, Topeka & Santa Fe, has been appointed acting roadmaster at Needles, Cal., replacing **Earl Delk,** who has been granted a leave of absence on account of illness.

A. W. Schroeder, supervisor of extra gangs of the Chicago, Burlington & Quincy, has been appointed to the newly-created position of assistant to engineer of track, with headquarters as before at Chicago, and the position of supervisor of extra gangs has been abolished.

G. M. Strawhun, track supervisor on the Colorado division of the Missouri Pacific, has been promoted to roadmaster with headquarters at Kansas City, Mo., succeeding **W. R. Payne,** who has been transferred to the Wichita division, with headquarters at Conway Springs, Kan. Mr. Payne succeeds **H. H. Gudger,** who has been promoted to assistant trainmaster. principal assistant architect, which position he held until his recent promotion to architect.

Bridge and Building

J. B. Kenyon has been appointed supervisor of bridges and buildings on the Lehigh Valley, with headquarters at Buffalo, N.Y., to succeed **C. W. Baker,** whose promotion to division engineer is reported elsewhere in these columns.

W. D. Conrad, master carpenter on the Monongahela division of the Pennsylvania, at Pittsburgh, Pa., has been transferred to the Eastern division, with headquarters at Canton, Ohio, to replace **G. P. Hayes,** resigned. **H. P. Greene,** assistant master carpenter on the Maryland division, has been promoted to branch line master carpenter on the Monongahela division, succeeding Mr. Conrad, and **S. G. Wintoniak,** bridge and building apprentice on the New York division, has been promoted to assistant master carpenter on the Maryland division.

Obituary

William W. Crowley, general inspector of maintenance on the Lehigh Valley, died at his home in Bethlehem, Pa., on October 8.

Theodore C. Wulling, resident engineer in the construction department of the Erie, at Cleveland, Ohio, who retired on April 15 after 48 years of service, died recently.

Leo T. Day, roadmaster on the Chicago & North Western, with headquarters at Proviso, Ill., died suddenly on October 25 at Evanston, Ill., while attending a football game.

David X. Greenberg, assistant engineer in the maintenance of way department of the Missouri Pacific, with headquarters in the general offices at St. Louis, Mo., died in the Missouri Pacific hospital at St. Louis on October 23.

Association News

Metropolitan Maintenance of Way Club

The first meeting of the season was held on Thursday, October 30, at the Hotel Sheraton, New York. The principal speaker was P. O. Ferris, chief engineer, Delaware & Hudson, Albany, N.Y., who spoke on "Training Foremen." In addition a sound motion picture was shown, entitled "Highlights in the Making of Steel," which was exhibited through the courtesy of the Bethlehem Steel Company.

Bridge & Building Association

President J. S. Hancock, bridge engineer of the Detroit, Toledo & Ironton, and president of the association, has called a meeting of the Executive Committee in Chicago on November 20. The primary purpose of the meeting, which will be held at the Chicago Engineers' Club, beginning at 9:30 a.m., will be to select the personnel of technical committees for the current year. Members are urged to volunteer for committee work and to return to the secretary the cards which have been mailed to them, indicating the committee or committees on which they desire to serve.

Roadmasters' Association

President A. B. Chaney, assistant engineer maintenance of way and structures of the Missouri Pacific, has called a meeting of the Executive committee to meet in Chicago on December 5 at the Chicago

(*Continued on page* 1146)

Meetings and Conventions

American Railway Bridge and Building Association—Annual meeting, September 21-23, 1948, Hotel Stevens, Chicago. Elise LaChance, secretary, 431 S. Dearborn street, Chicago 5.

American Railway Engineering Association—Annual Meeting, March 16-18, 1948, Chicago. W. S. Lacher, secretary, 59 E. Van Buren street, Chicago 5.

American Wood-Preservers' Association—Annual meeting, April 27-29, 1948, St. Paul, Minn. H. L. Dawson, secretary-treasurer, 1429 Eye street, N.W., Washington 5, D. C.

Bridge and Building Supply Men's Association—Joint exhibit with Track Supply Association, September 21-23, 1948, Hotel Stevens, Chicago, during concurrent conventions of American Railway Bridge and Building Association and Roadmasters' Association. E. C. Gunther, secretary, 122 S. Michigan avenue, Chicago 3.

Maintenance of Way Club of Chicago—Next meeting, November 24, 1947. C. R. Knowles, secretary-treasurer, 105 W. Adams street, Chicago 3.

National Railway Appliances Association—Thirty-third annual exhibit, Chicago, March 15-18, 1948, in connection with A.R.E.A. convention. C. H. White, secretary, 208 S. LaSalle street, Chicago 4.

Roadmasters' and Maintenance of Way Association of America—Annual meeting, September 21-23, 1948, Hotel Stevens, Chicago. Elise LaChance, secretary, 431 S. Dearborn street, Chicago 5.

Track Supply Association—Joint exhibit with Bridge and Building Supply Men's Association, September 21-23, 1948, Hotel Stevens, Chicago, during concurrent conventions of Roadmasters' Association and American Railway Bridge and Building Association. Lewis Thomas, secretary, 59 E. Van Buren street, Chicago 5.

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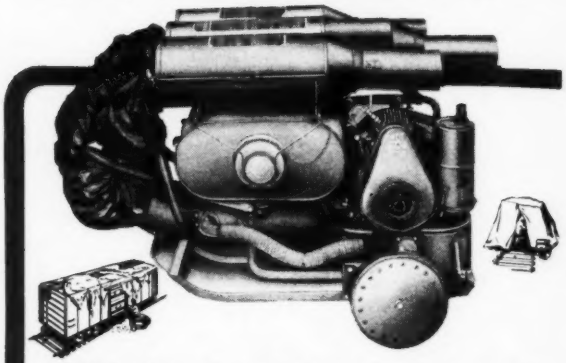

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● Wintertime poses a lot of problems for railroads. Frozen pipes, ice on car doors and other headaches. Here's a solution . . . quick, low cost, safe heat . . . instant *torrents* of heat! Preheat refrigerator cars. Helps in thawing frozen residue on floors of cattle cars. Use it to warm up shelters, warehouses, work and tool sheds. Has scores of uses, when and where you need it.

Plant weighs 250 lbs. Can be pulled over snow with sled bottom or pulled on retractable wheels on the ground. 1½ horse power. Three flexible ducts—one 16 feet long, two 10 feet—pipe heat to any desired spots. Develops 100,000 B.T.U.'s per hour on 1¼ gal. of gasoline. Turbine blower, air cooled engine. Starts easily by pulling a cord (like outboard motor).

Army used this machine in the Arctic for most rugged below zero performance. Limited supply. All brand new and fully guaranteed. Cost government $600. While they last

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Please ship at once, by ( ) fast freight ( ) express one Stewart-Warner PORTABLE HEATING PLANT. Enclosed find ( ) check ( ) money order for $295. Ship with transportation charges collect.

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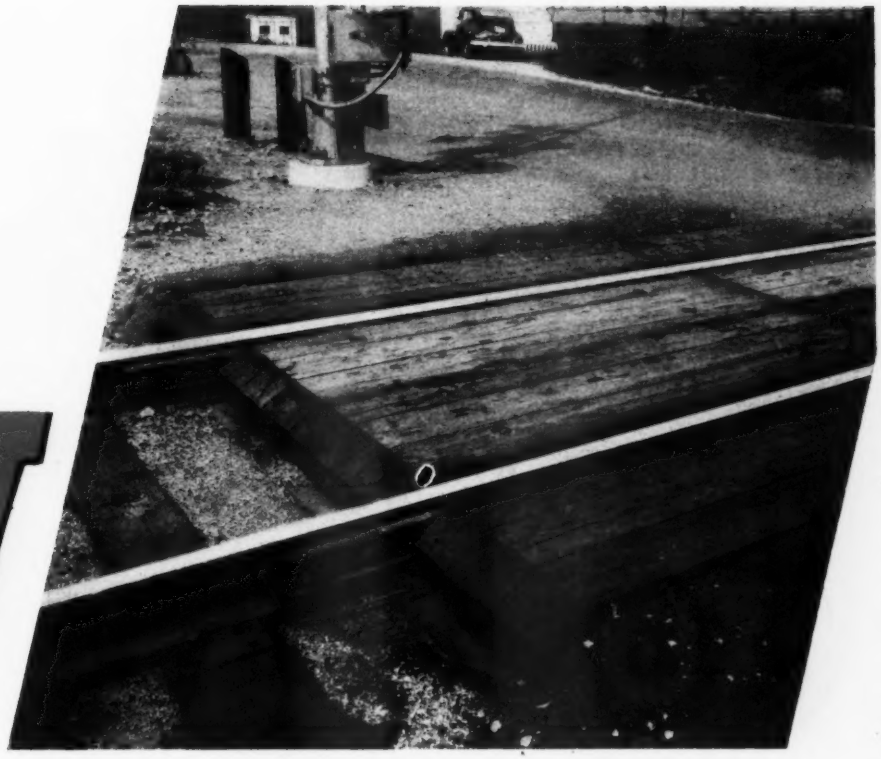

What do you require of your GRADE CROSSINGS?

While there is considerable difference of opinion among railroad men as to crossing details, most will agree in requiring a smooth surface, long life, and long-term economy of maintenance. Match your ideas against the following, which is a partial list of Moss Crossing characteristics:

MC DURABLE — Many crossings in service 16 years with no apparent deterioration.

MC SMOOTH — The width of the assembled sections makes for a very smooth surface.

MC SHIPPED READY TO INSTALL — No cutting and fitting on the job.

MC BUILT FOR HEAVY DUTY — Moss crossings are as rugged as the track.

MC VERSATILE — Pre-framed for single or multiple, tangent or curved track. Adapted to crossings through railroad turnouts. Equally suitable whether crossing is at 90° or 30° angle with track.

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MT. VERNON, ILL.
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GRANVILLE, WIS.
SHREVEPORT, LA.
COLUMBUS, MISS.

(*Continued from page* 1142)

Engineers' Club. The meeting, which will convene at 9:30 a.m., will be concerned primarily with the selection of the personnel of technical committees to make studies for reports to be presented at the next annual convention. To the end that assignments to committees will be in accordance with their wishes, members are urged to return promptly the "preference cards" mailed to them recently by the secretary.

Maintenance of Way Club of Chicago

The next meeting of the club will be held on November 24 at Harding's at the Fair, and, following dinner at 6 p.m., will be addressed by W. T. Rice, superintendent of Potomac Yard, Richmond, Fredericksburg & Potomac, at Alexandria, Va. Mr. Rice, an engineer by training and experience, will speak on Modern Yard Maintenance.

The October 27 meeting of the club, with 133 in attendance, saw two outstanding color-sound motion pictures, both treating safety from a realistic viewpoint, and each vividly reconstructing a series of accidents that have actually occurred involving employees in the maintenance of way and structures department. One of these, entitled "Maintenance of Way Mishaps," was produced on and made available by the Southern Pacific, and the other, "Use Your Head," was produced on and made available through the courtesy of the Denver & Rio Grande Western.

American Railway Engineering Association

Meetings of the Board of Direction and of the Nominating committee are scheduled to be held at Chicago on November 17. In addition to considering routine matters the board will be apprised of the results of the letter-ballot vote on the proposed increases in membership dues.

With the November issue of the A.R.E.A. News, which was mailed late in October, the members received a letter ballot proposing changes in the drilling of the 115-lb., 132-lb. and 133-lb. rail sections and corresponding changes in the punching of the joint bars. These changes were voted by the Committee on Rail and were approved by the Board of Direction. In handling the matter by letter ballot at this time it is hoped to make the changes effective, assuming they are approved by the membership, with rail purchases for delivery in 1948.

Four standing committees have definitely scheduled meetings to be held during November, three of which will be held at Chicago. These latter include meetings of the Committees on Wood Bridges and Trestles, on November 12; the Committee on Track, November 13; and the Committee on Rail, November 21. In addition the Committee on Records and Accounts has scheduled a meeting to be held at Washington, D. C., on November 12 and 13. The Committee on Cooperative Relations With Universities also plans to hold a meeting during November, but at the time of going to press the date had not been established.

Five commitees held meetings during October. These include the Committee on

(*Continued on page* 1148)

(*Continued from page* 1146)

Waterproofing, which met at Chicago on October 1 and 2; the Committee on Economics of Railway Labor, which met at Chicago on October 17; the Committee on Iron and Steel Structures, at Chicago on October 29 and 30; the Committee on Wood Preservation, at Chicago on October 30; and the Committee on Ties which met in Texas on October 22 and 23. On the first day of its meeting the Committee on Ties inspected a tie-treating plant at Sommerville, while on the second day it inspected a similar plant at Houston, and also held a session to consider subcommittee reports at the same point.

Supply Trade News

Personal

William M. Kinney, vice-president for promotion of the **Portland Cement Association,** at Chicago, has retired.

Paul S. Park has been appointed manager of the engineering service department of the **A. M. Byers Company,** Pittsburgh, Pa.

C. F. Wiley has been promoted to assistant manager of the district sales office of the **American Steel & Wire Co.,** a subsidiary of the United States Steel Corporation, with headquarters at Chicago.

Thomas W. Krueger, formerly with the Jones & Laughlin Steel Corp., has been appointed advertising manager of the **Duff-Norton Manufacturing Company,** Pittsburgh, Pa.

C. B. O'Neil, manager of the railroad department at St. Louis, Mo., for **Fairbanks-Morse & Co.,** has also been placed in charge of the sale of Diesel locomotives in the St. Louis area and the southwest. In this capacity Mr. O'Neil succeeds to the duties formerly handled by **Frank Ross,** resigned.

B. H. Johns, manager of the St. Louis (Mo.) branch of the **Independent Pneumatic Tool Company,** has been appointed manager of the company's mining and contractors tool sales division, with headquarters at Chicago. Mr. Johns will be succeeded by **W. B. Smith,** manager of the firm's Houston (Tex.) office, who, in turn, is succeeded by **R. F. Caslin.**

E. L. Klopfer has joined **Morrison Metalweld Process, Inc.,** Buffalo, N.Y., to research its track appliance and field operations. Mr. Klopfer was graduated from Lehigh University in June, 1947, with a B. S. degree in metallurgical engineering. The appointment of **M. L. Morrison,** formerly a member of the estimating and engineering department, as assistant to the vice-president, also was announced.

R. W. Bayerlein, whose promotion to vice-president of the **Nordberg Manufacturing Company,** Milwaukee, Wis., was reported in the October issue, joined

(*Continued on page* 1150)

Teamwork—

YOU'RE TALKING ABOUT A RAILROAD

Yes sir, it takes all kinds of teamwork to keep a railroad running on schedule. Each job, whether large or small, is an important part of the whole system. No small part of the splendid teamwork is the result of demanding and using the best possible equipment, especially the tools required for maintenance.

The TRACK, for instance, if not properly maintained, can spoil the rest of the teamwork. That's why most railroads use mechanical tamping, originated by Ingersoll-Rand. Most railroads use I-R air-operated MT-3 Tie Tampers—they are the lightest tampers available. The machine does the fatiguing work while the operator simply guides it.

Improve your teamwork and TRACK by using Ingersoll-Rand tie tampers and I-R off- and on-track air compressors.

Ingersoll-Rand

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ORIGINATOR OF MECHANICAL TAMPING

AIR TOOLS
COMPRESSORS
CONDENSERS
ROCK DRILLS
TURBO BLOWERS
CENTRIFUGAL PUMPS
OIL & GAS ENGINES

(*Continued from page* 1148)

Nordberg in 1919, when he became an apprentice in the Nordberg shops as a co-op engineering student of Marquette University. Since receiving his degree in mechanical engineering in 1924, Mr. Bayerlein has served as sales engineer, on estimating, power plant analysis and the formulation of proposal specifications for steam and Diesel engines. In 1933 he was appointed assistant to the vice-president in charge of sales and engineering, heavy machinery division, and two years later he was advanced to manager of that division.

James G. Lyne, assistant to the editor of the Railway Age, has been appointed editor to serve jointly in that capacity with **Samuel O. Dunn.** Mr. Lyne is also vice-president, assistant to chairman and a director of the Simmons-Boardman

James G. Lyne

Publishing Corporation, which publishes Railway Age, *Railway Engineering & Maintenance* and other railway and business publications.

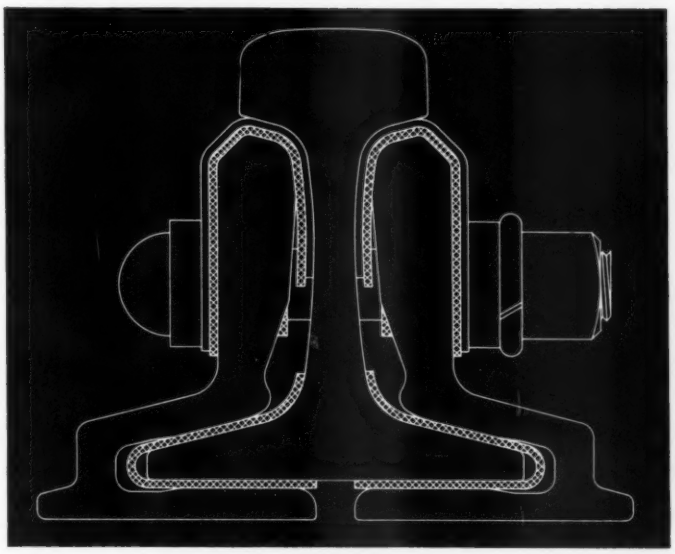
Born in St. Louis, Mo., on July 10, 1898, Mr. Lyne spent his early years in Slater, Mo., and Herington, Kan. He was graduated from the University of Kansas in 1920 and holds the degree of doctor of philosophy from New York University. Mr. Lyne first entered railroad service in 1914 and worked intermittently in various minor capacities in the operating, engineering and mechanical departments of the Rock Island at Herington and Armourdale, Kan. After serving briefly in the army during World War I he worked during 1919-20 as a special agent for the Bureau of Labor Statistics, Washington, D.C. He was also employed for a time as a reporter on the "Daily News," the New York tabloid. In October, 1920, Mr. Lyne joined the editorial staff of the Railway Age and in 1928 he became financial editor, being advanced to assistant to editor in 1938. He has been a vice-president and director of the Simmons-Boardman Publishing Corporation since 1943 and has held the position of assistant to chairman of this company since November, 1946.

The **Timken Roller Bearing Company** has announced the appointment of **H. C. Edwards,** formerly chief engineer of research and development, as directors of

(*Continued on page* 1152)

INSULATED JOINTS

APPLICATION AND MAINTENANCE



ARMORED

You are using the best design of joint and quality of material and workmanship that our 50 years of experience enables us to furnish.

We recommend careful consideration and observation of the following rules which for many years have been recognized as governing the efficient and durable service of Insulated Rail Joints. Failure to observe any one or more of these rules will result in shortening the life of the insulating material and in some instances detracting from the strength of joint and rail. It is more costly in material and labor to remove and renew a joint frequently, than to apply it correctly in the first place and then keep it in good condition by occasional maintenance work.

We believe that conditions resulting from excessive war-time traffic and shortage of labor warrant, at this time, the careful consideration of this subject by all maintenance and signal officials.

Copies of these rules will be mailed upon request.

THE RAIL JOINT COMPANY Inc.

50 CHURCH ST. NEW YORK 7, N. Y.

(*Continued from page* 1150)

research and development, to succeed **J. F. Leahy,** who has retired after 45 years of service with the company. **Walter F. Green,** formerly assistant manager of research and development, has been appointed manager of research and development. The appointments of **H. M. Shank,** formerly Boston, Mass., branch manager of the service-sales division, at Detroit, Mich., branch manager, to succeed **J. D. Jesseph,** resigned, and **Frank M. Barry,** formerly a field representative in the New York office, as manager of the Boston branch, also were announced.

O. L. Howland, whose appointment as sales manager of the welding division of the **Metal & Thermit Corporation,** with headquarters in Chicago, was reported in the October issue, was graduated

O. L. Howland

from the University of Wisconsin, after which he began his business career with a surveying party of the Phelps-Dodge Corporation in Mexico. During World War I he served in the merchant marine, immediately after which he joined the Central Steel & Wire Co. of Chicago, as a welding specialist. In 1924 he joined the Lincoln Electric Company as a district manager in Indianapolis, Ind., and two years later returned to Central Steel & Wire. From 1927 to 1931 he was general manager of the Koro Corporation. In 1932, he was appointed eastern manager for the Hollup Corporation and, in 1936, sales manager at the Chicago office. Mr. Howland headed the War Production Board's welding division in Washington, D. C., during the recent war.

Trade Publications

(To obtain copies of any of the publications mentioned in these columns, use postcards, page 1077)

Handbook of Frame Constants—This is the title of a 32-page booklet, recently published by the Portland Cement Association, which is intended to ease the work of designing concrete members where carryover and distance factors and fixed-end moments are involved. The handbook contains 57 tables in which 27,050 constants for 1,390 members are given. In addition, other tables show the integrals by which the tabulated coefficients

(*Continued on page* 1154)

(*Continued from page* 1152)

were computed and by means of which the tabular information in the booklet may be extended. Further explanation and description of these integrals are given in a section entitled Derivations.

Building Maintenance—The Stonhard Company has published "Over the Rough Spots" a 48-page booklet which deals with more than a hundred problems encountered in the maintenance and construction of industrial buildings, and outlines the characteristics, advantages, typical uses, and application of Stonhard maintenance materials for floors, walls, and roofs. Profusely illustrated with photographs of a large variety of applications, the booklet includes sections dealing with the special problems of railroads, mines, public utilities and water works.

Off-Track Equipment Serves the Railroad—This is the title of a 16-page booklet published by the Caterpillar Tractor Company, describing the use of Caterpillar tractors and tractor-operated equipment in railway construction and maintenance work. Largely pictorial, the booklet shows this equipment at work on a number of specific projects and gives production and cost figures on several of them. The illustrations not only include earth-moving work, but also show the equipment at work on such projects as rail laying, crib cleaning, ballasting, snow removal, grouting and bridge work.

Wrought Iron for Radiant Heating.—A new 52-page handbook has been published by the A. M. Byers Company, Pittsburgh, Pa., entitled "Byers Wrought Iron for Radiant Heating," which explains how to calculate, design and install radiant heating systems for buildings ranging from monumental-type structures to small industrial buildings. This working manual outlines the detailed procedure for figuring heat losses and piping requirements, and for designing the coils and supply and return mains. Factual data is presented on the relative merits of locating the coils in floor and ceiling. Included also is a full-page drawing of a floortype radiant heating system for a representative building in which both sinuous coils and grids are used. The book records in picture and text 23 typical installations covering a wide range of structures. In addition to chapters on the theory, history and achievements of radiant heating in more than a thousand installations functionig in the United States, the handbook devotes 12 pages to answering the 34 questions that have been asked most frequently during the last seven years at lectures on radiant heating and in letters to the company.

Wolman Salts and Minalith—In a recently issued four-page illustrated folder, the American Lumber & Treating Company describes the composition, functions and application of two of its products. These are Wolman salts for treating lumber against decay and Minalith fire-retardant salts for protecting wood against combustion. Brief specifications for treating lumber with these two products are also included.

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is all you need
for Drilling with this NEW
SKIL* Drill
BENCH STAND

● Everybody who has given this SKIL Drill Bench Stand a trial is surprised at how little hand pressure it takes to do a drilling job . . . surprised too, at the extreme drilling accuracy provided by this precision built stand. A new rack and pinion gear gives you 20 to 1 leverage, even with the short standard length lever. A longer lever gives still higher pressure ratios. This SKIL Drill Stand is made in sizes to fit all current models of Portable Electric SKIL Drills. (Model "80" is illustrated.)

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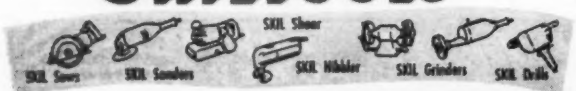
ELECTRIC PNEUMATIC
SKILTOOLS



MADE BY SKILSAW, INC.

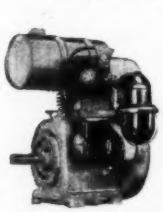
"Patrol" Compressor, made by Chicago Pneumatic Tool Company powered by VP4 Air-Cooled Engine.

How to GET
THE MOST MANPOWER HOURS OF PRODUCTIVE LABOR *Out of Your Track Gangs . . . . . .*

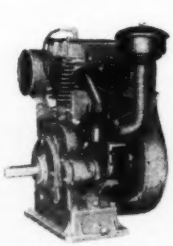
When manpower is dependent upon Engine Power for sustained effort . . . the problem of maintaining a high level of labor productivity logically falls on the power unit.

Because Wisconsin Air-Cooled Engines deliver the Most H.P. Hours of on-the-job service, due to the heavy-duty design and construction of these engines and their trouble-free air-cooling, you are always sure of a continuous flow of power from engine to tools . . . with an absolute minimum of power interruptions or layups. Manpower puts in its best licks . . . labor productivity keeps pace with power productivity. Roadbed maintenance costs are lowered; you get more "mileage" per day, per week, per month out of your track gangs.

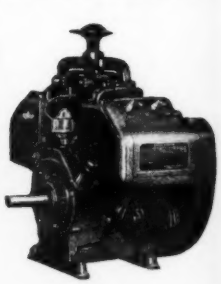
For utmost operating dependability and economy, specify "Wisconsin Engine" on your motorized equipment. These heavy-duty engines are available in a full range of types and sizes from 2 to 30 H.P.



Models AB and AK 4-cycle single cyl. engines available in 2 to 4 hp. sizes.

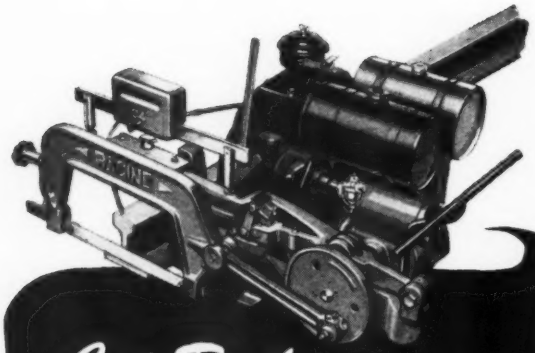


Models AEH, AFG, AGH, AHH 4-cycle single cyl. engines, 4 to 9 hp.



Models VE-4 and VP-4 V-type, 4 cyl. engines up to 30 hp.

WISCONSIN MOTOR Corporation
MILWAUKEE 14, WISCONSIN
WORLD'S LARGEST BUILDERS OF HEAVY-DUTY AIR-COOLED ENGINES



Cut Rail . . . RIGHT ON THE TRACK *with . . .*

RACINE PORTABLE Rail Saws

Your track maintenance and repairs can be speeded up with Racine Portable Rail Cutting Machines. This equipment cuts rail ends right on the track. No extra handling or hauling of the rail to central cropping plant.

Only one man needed to operate the Racine Rail Saw. Two men can easily carry it from rail to rail. These fast, accurate machines produce smooth, clean cuts without the overheating of rail ends that so often starts fractures leading to rail failure. Model 15 for rails to 7⅜" high; Model 16 for rails to 10" high.

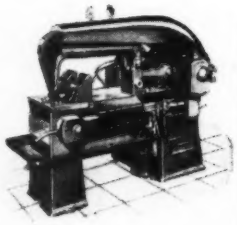
SIX COMMON JOBS FOR THIS MACHINE

1. Cutting and fitting rails at interlocking plants, crossings and switches.
2. Closing track in rail-laying operations.
3. Smooth, accurately cut rail for insulated joints.
4. Proper staggering of joints in curves.
5. Removing split, worn and battered rail ends.
6. Cutting out sections of wheel burned rails and fissures.

Models are available with gas engines, compressed air or electric motors. Write for complete catalog No. 58A. Address RACINE TOOL AND MACHINE CO., 1738 State St., Racine, Wisconsin.

RACINE HEAVY DUTY METAL SAWS FOR RAILROAD SHOPS

Cut axle shafts, boiler pipe, channels, angles and beams quickly and accurately. Models are available in all price ranges for either high speed production metal cutting or general all around shop work. Capacities 6" x 6" to 20" x 20". Ask for general catalog No. 12 giving description of complete Racine Saw line.



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Blaw-Knox has made it quick and easy for railroaders to select the right bucket for the job in question and the crane capacity available. Whether it's for ash pit service, coaling, ballast handling, digging, or river-rail terminal work, *Bulletin 1989* will show you how well Blaw-Knox Buckets are adapted to these various requirements. Your request will bring a copy of Bulletin 1989 by return mail.

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BLAW-KNOX *CLAMSHELL* **BUCKETS**

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946

Of Railway Engineering and Maintenance published monthly at Chicago, Ill., for October 1, 1947.

State of Illinois} ss.
County of Cook}

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Neal D. Howard, who, having been duly sworn according to law, deposes and says that he is the Editor of the Railway Engineering & Maintenance and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily, weekly, semiweekly or triweekly newspaper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946 (section 537, Postal Laws and Regulations), printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Simmons-Boardman Publishing Corp., 105 W. Adams Street, Chicago, Illinois; Editor, Neal D. Howard, 105 W. Adams Street, Chicago, Illinois; Managing Editor, Merwin H. Dick, 105 W. Adams Street, Chicago, Illinois; Business Manager, S. Wayne Hickey, 105 W. Adams Street, Chicago, Illinois.

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4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

NEAL D. HOWARD,
Editor.

Sworn to and subscribed before me this 26th day of September, 1947.
[SEAL] RALPH E. WESTERMAN, Notary Public.
(My commission expires February 3, 1949.)

LESS LABOR IS REQUIRED TO INSTALL AND MAINTAIN Q&C MANGANESE GUARD RAILS

The use of Q&C one-piece Manganese Guard Rails will speed up the work of laying rail through turnouts, since there are no separate braces, bolts, plates and foot guards to be assembled.

The wear resistant manganese steel eliminates the need for frequent adjustments, resulting in economy in maintenance.

Specify them on your requisitions.

THE Q AND C COMPANY

Chicago, 5. New York, 6. St. Louis, 1.

Plastic Rock!

—ideal for Railroad Platforms

Big job at New Haven, Connecticut, for N. Y., N. H. & H. R. R. . . . Installed on Saturday — IN SERVICE on Monday!

Plastic Rock comes complete, packed in barrels. Nothing more to buy. No application "formula" to confuse you. Simply mix and trowel; sticks to concrete, wood, steel; average depth ½". Old floor Saturday, new floor Monday; hundreds of tons rolling on steel wheels only improve it; 7-year-old floors show no wear. Ideal for freight platforms, station floors, coach floors, ramps. Plastic Rock is spark-proof, skid-safe even when wet, dustless, noiseless; feels like cork under foot; cannot splinter, crack, crumble, curl or loosen. Used by largest railroads and industries. First choice of maintenance superintendents. Your contractor or your own crew can apply.

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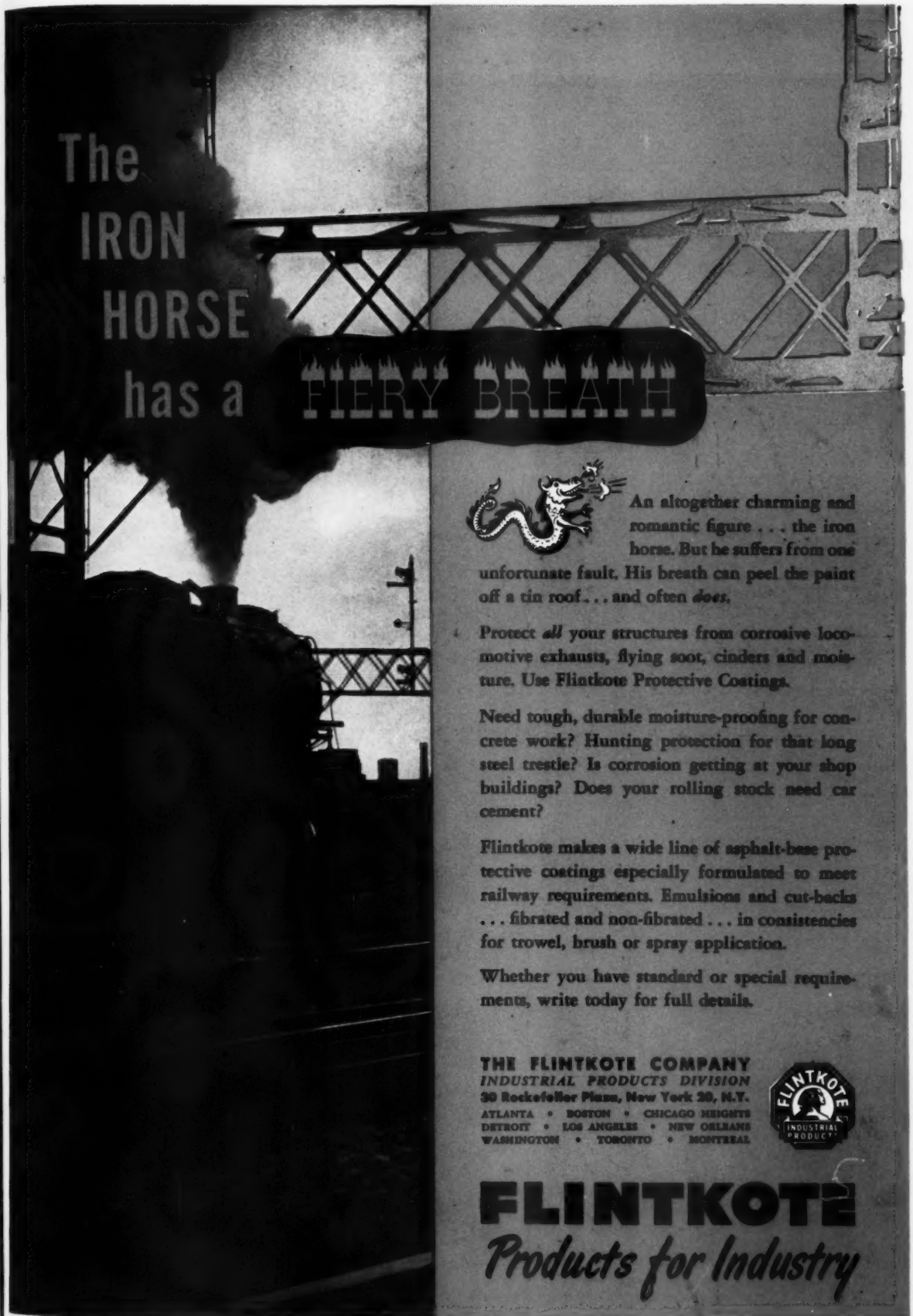
ALPHABETICAL INDEX TO ADVERTISERS, NOVEMBER, 1947



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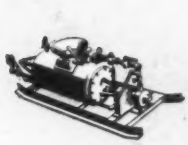

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